PHYSICS ABSTRACTS

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of

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NOTE ON THE ARRANGEMENT OF ABSTRACTS

The Abstracts are classified by subject according to the Universal Decimal Classification, and arranged in order of their U.D.C. numbers. (An abridged version of the U.D.C. accompanies the Annual Index.) An Abstract of interest under more than one head has additional U.D.C. numbers, linked by the colon sign, " : " e.g. "536.21 : 548.0 Conduction of heat in crystals." The Abstract is printed once only, under the main number, e.g. in the section "HEAT 536," but Cross-references are inserted under the other numbers, e.g. "548.0 : 536.21 *see Abstr.* 1234" in the section "CRYSTALLOGRAPHY 548." These Cross-references should be investigated, therefore, when a particular section is being searched, as they contain additional matter relevant to that section. A Cross-reference does *not* refer to the Abstract which appears immediately above it.

Abstracts signed with the following initials have been supplied by the courtesy of the organizations named: "E. R. A." = British Electrical and Allied Industries Research Association. "M. A." = Metallurgical Abstracts. "M.-V." = Metropolitan-Vickers Electrical Co., Ltd. "P. O." = Post Office Engineering Research Department.

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MATHEMATICS 51

511.2 : 531.19 *see Abstr.* 1796

512.25 : 512.831 1756

The solution of three-term simultaneous linear equations by the use of submatrices. MORRISON, I. F. *Engng J., Montreal*, **29**, 80–3 (*Feb.*, 1946).—Matrix methods previously described by Duncan [Abstr. 776 (1945)] for solving a large number of linear equations are extended to apply to a set of equations in which each equation consists of only three terms in such a way that the matrix of the set has non-zero elements only in the principal diagonal and the diagonals immediately above and below it. A simple step by step process is given by which the reciprocal matrix may be obtained. A numerical example is discussed. L. S. G.

512.52 : 533.6.013.4 1757

Bi-variate partial fractions and their applications to flutter and stability problems. FRAZER, R. A. *Proc. Roy. Soc. A*, **185**, 465–84 (*April* 5, 1946).—If $P(x, y)$ is a complete bi-variate polynomial of interpolation, of degree n, containing $\frac{1}{2}(n+1)(n+2)$ terms, an expansion of the form

$$\frac{P(x, y)}{L_1 L_2 \ldots L_{n+2}} = \sum_{i \neq j} \frac{A_{ij}}{L_i L_j}$$

is considered, where

$$L_i \equiv y - p_i x + q_i = 0 \qquad (i = 1, \ldots, n+2)$$

is a particular system of straight lines chosen to define the points for interpolation. Application is made to the expansion of determinants of the form

$$\Delta(\lambda, y) \equiv |a_{ij}\lambda^2 + b_{ij}\lambda + c_{ij} + e_{ij}y|$$

which arise in considering the flutter and stability of aeroplanes, and a particular example is studied in detail. It is noted briefly that a d.c. network analyser, based on an electrical interpretation of the expansion formulae, could possibly be used as an aid to a rapid solution. L. S. G.

512.831 : 512.25 *see Abstr.* 1756

513.813 1758

On the projective theory of two dimensional Riemann spaces. THOMAS, T. Y. *Proc. Nat. Acad. Sci., Wash.*, **31**, 259–61 (*Aug.*, 1945).—In such a space the existence of a simple vector invariant is demonstrated. The vanishing of this vector is a necessary and sufficient condition for the space to be of constant curvature in the projective sense. L. S. G.

513.813 1759

Absolute scalar invariants and the isometric correspondence of Riemann spaces. THOMAS, T. Y. *Proc. Nat. Acad. Sci., Wash.*, **31**, 306–10 (*Sept.*, 1945).—Conditions for the correspondence are given in terms of the absolute scalar invariants. This is done for a space R_n, but the details are worked out considerably further in the case of spaces R_2. L. S. G.

513.813 1760

On parallelism in Riemannian space. II. SEN, R. N. *Bull. Calcutta Math. Soc.*, **37**, 153–9 (*Dec.*, 1945).—A continuation of earlier work [Abstr. 1191 (1945)]. The Riemann–Christoffel tensor is expressed in terms of the parallelism. Expressions are also obtained for the contracted curvature tensor and other tensors and invariants. These include a divergence formula for a skew-symmetric contravariant tensor of the second rank. L. S. G.

513.82 = 3 1761

An extension of the Steiner–Minkowski proposition for polyhedra. HADWIGER, H. *Experientia*, **2**, 70–1 (*Feb.* 15, 1946) *In German.*

517.22 : 530.145 = 4 1762

On the operator $\exp(x + d/dx)$. VILLE, J. *C. R. Acad. Sci., Paris*, **221**, 529–30 (*Nov.* 5, 1945) *In French.*—Let $R_n = (x + d/dx)^n$, $S_n = [x + d/dx]^n$, where, in R_n the order of the terms is taken into account in calculating the nth power, and in S_n the x always precedes d/dx. The recurrence relation $R_{n+1} + xR_n + R_n d/dx + nR_{n-1}$, is used to show that $R_{n+1} = P_{n+1}\{[x + d/dx]\}$, where $P_n(u)$ satisfies $P_{n+1}(u) = uP_n(u) + nP_{n-1}(u)$. The solution of the last equation, obtained by the method of generating functions, is $P_n(u) = \left[\frac{d^n}{dt^n} \exp(\frac{1}{2}t^2 + ut)\right]_{t=0}$. The function $\exp(x + d/dx)$ is defined by

$$\exp(x + d/dx) = \sum_{n=0}^{\infty} \frac{1}{n!} R_n$$

and it is shown that

$$\exp(x + d/dx) f(x) = \exp(x + \tfrac{1}{2}) f(x + 1)$$

This operator finds application in quantum mechanics and an example is given. L. S. G.

517.91 : 534.015 *see Abstr.* 1826

517.942.9 1763

The Laplace equation in space. KASNER, E., AND DE CICCO, J. *Proc. Nat. Acad. Sci., Wash.*, **31**, 247–9 (*Aug.*, 1945).—A function is said to be harmonic if it satisfies Laplace's equation. In 3 dimensions a family of surfaces $f(x, y, z) = c$ is isothermal if, and only if, f is a function of a harmonic function and, thus, if f satisfies 2 partial differential equations of the 3rd order. Five new theorems are proved concerning isothermal families. One of these states that Lie's characterization of isothermal families in the plane is not valid in space. Another states that the only point transformations converting every isothermal system of surfaces into an isothermal system are those of the Liouville inversive group. Differential conditions on p and q are given in order that the equations

$$\partial z/\partial x = p(x, y, z) \quad \partial z/\partial y = q(x, y, z)$$

shall possess as solution an isothermal family of surfaces. L. S. G.

517.942.932 = 4 1764

On Mathieu's equation. WAVRE, R. *C.R. Soc. Phys. Hist. Nat. Genève*, **62**, 54–5 (*April–July*, 1945)

In French.—The equation, which arises in various physical problems, is

$$d^2u/dx^2 + (c + a\cos x + b\sin x)u = 0$$

It is shown how a solution may be obtained by the use of infinite determinants. This is transformed into a solution in the form of a rapidly converging series. [See also Abstr. 1196 (1946)]. L. S. G.

517.948 : 526.1 1765

Some integral equations of potential theory. BATEMAN, H. *J. Appl. Phys.*, **17**, 91–102 (*Feb.*, 1946).—A review is made of problems in the theory of attractions relating to the figure of the earth. These are formulated as integral equations. The guiding equation, of considerable importance in the theory of methods of geophysical prospecting, is

$$f(x) = \pi^{-1}\int_{-\infty}^{\infty} \frac{yF(t)dt}{(x-t)^2 + y^2}$$

where y is a fixed constant. Inversion formulae, giving the solutions of this equation and its conjugate equation, are obtained and a solution is also obtained by means of orthogonal functions. The guiding equation is generalized and problems in 3 dimensions are considered. Various other integral equations are considered. One of these may be solved by Laplacian integrals and Erdélyi's interpolation formula for such integrals [Abstr. 18 (1944)] is discussed. A solution is given of an integral equation which, in a special case, arises in the exchange problem in the theory of crystals [Abstr. 504 (1939)]. L. S. G.

518.3 = 3 1766

A method for constructing simple nomograms. DEGEN, A. *Bull. Ass. Suisse Élect.*, **36**, 346–9 (*May* 30, 1945) *In German.*—An elementary process is described for setting up nomograms to represent (1) a product ab, (2) a quotient a/b, (3) a 2-term expression $ab + k$ (k = constant), (4) the logarithm of ab. The method is extended to expressions of the form $(a_1a_2a_3 \ldots b_1b_2b_3 \ldots)/(c_1c_2c_3 \ldots)$. As an example a nomogram is constructed for calculating the copper losses in a conductor, given the length, diameter and specific resistance of the m separate wires forming the conductor, and the current in each wire. L. S. G.

519.2 : 621.315.212 : 621.3.09 = 4 1767

Statistical study of irregularities in coaxial cables. I–III. Application to the calculation of echoes and after-effects. VILLE, J. *Bull. Soc. Franç. Élect.*, **4**, 215–41 (*Nov.*, 1944) *In French.*—[Abstr. 1510 B (1946)].

519.2 : 621.315.212 : 621.3.09 = 4 1768

Statistical study of irregularities in coaxial cables. IV. Reduction of after effects by grouping lengths of cable. VILLE, J. *Bull. Soc. Franç. Élect.*, **4**, 253–60 (*Dec.*, 1944) *In French.*—[Abstr. 1511 B (1946)].

519.24 : 677.1 : 620.172.2 = 3 1769

Probability problems in tensile strength testing of yarn. ROTT, N. *Schweiz. Arch. angew. Wiss. Tech.*, **12**, 93–5 (*March*, 1946) *In German.*

519.242.331 1770

A criterion for the reality of cyclic variations. GLEISSBERG, W. *Nature, Lond.*, **157**, 663–4 (*May* 18, 1946).

519.251.8 1771

Linear "curves of best fit." AUSTEN, A. E. W., AND PELZER, H. *Nature, Lond.*, **157**, 693–4 (*May* 25, 1946).—Discusses the procedure for finding the best estimate of the relation $w = Pv$ when both w and v are subject to normal errors. The solution given is of wide application.

519.251.8 = 4 1772

Determination, by the condition of least error, of the polynomial of the second degree representing as closely as possible the points of an experimental curve. VERNOTTE, P. *C.R. Acad. Sci., Paris*, **221**, 609–11 (*Nov.* 19, 1945) *In French.*—An extension of previous work [Abstr. 444 (1945)]. A method is now given for finding A, B and C where $Ax^2 + Bx + C$ fits $2n + 1$ given points as closely as possible. L. S. G.

519.272 1773

On the characteristic function of the distribution of the product of two normal variates. IRWIN, J. O. *Proc. Camb. Phil. Soc.*, **42**, 82–4 (*Jan.*, 1946).—Discusses the distribution of the product of two normal deviates from the population in the non-central case when the deviates are from any origin. The integral formula for the characteristic function is evaluated explicitly in the central case and is simplified in the non-central case. L. S. G.

519.281.2 1774

On the accuracy of least squares solutions. BANACHIEWICZ, T. *Ark. Mat. Astr. Fys.*, **31 B** (*No.* 3) *Paper* 8, 3 *pp.* (1945).—An application is made of previous work by the author to the determination of the relative errors of the unknowns in a given set of normal equations. A numerical example is given. Arrays similar to matrices but possessing a different definition of multiplication are used. L. S. G.

ASTRONOMY . GEODESY 52

521.12 : 531.261 = 4 1775

On a correction to Newton's Law. CHAZY, J. *Bull. Astr., Paris*, **12** (*No.* 2) 89–97 (1940) *In French.*—The *ad hoc* law of gravitation considered is $Gmm'(1 + \varepsilon r)/r^2$ where G is the constant of gravitation and ε is a small positive constant. A vector method is employed to calculate the radial, transverse and orthogonal components of this force. G. C. McV.

523.2 1776

On a new theory of Weizsäcker on the origin of the solar system. CHANDRASEKHAR, S. *Rev. Mod. Phys.*, **18**, 94–102 (*Jan.*, 1946).—Weizsäcker imagines that stars are formed by the condensation of a primeval interstellar material and, in the last stages of formation, the star is surrounded by a thin flat disc of the material. It can be proved that this disc will break up into a series of rings of quasi-stable vortices. In the regions between these rings secondary vortices form and develop into planets. The planetary formation is due to the fact that any dust particle in the turbulent region, larger than the average particle, grows first by capture of smaller particles in collisions and then by gravitational captures. The principal

result of the theory is a theoretical interpretation of Bode's law. The successive regions of secondary vortices, given probable values for the constants involved, follow very closely the sequence given in Bode's law. G. C. McV.

523.752 1777

The trajectories of eruptive prominences. PETTIT, H. B. *Publ. Astr. Soc. Pacif.*, **56**, 21–6 (*Feb.*, 1944).—Most eruptive prominences are found to be ejected at angles with the vertical less than 30°. All trajectories consist of straight-line segments. T. G. C.

523.755 1778

The line spectrum of the solar corona. SWINGS, P. *Publ. Astr. Soc. Pacif.*, **57**, 117–37 (*June*, 1945).—A review of Edlen's work and of the problems which it raises. T. G. C.

523.823/.83 1779

Stars nearer than 5 parsecs. VAN DE KAMP, P. *Publ. Astr. Soc. Pacif.*, **57**, 34–41 (*Feb.*, 1945).—Contains a list of 39 near stars with much information as to brightness, colour, motions, etc. 16 of the list are known to be multiple. The distribution of absolute magnitudes is given. The list is fairly complete to $M = +12{\cdot}5$, but more complete data is desirable. E. G. M.

523.841.3 1780

The long-period variable star RT Cygni. PETTIT, M. S. *Publ. Astr. Soc. Pacif.*, **56**, 107–11 (*June*, 1944).—A light curve is obtained from 150 observations with a visual wedge photometer in 1943–44, and the mean light curve for the past 42 periods from A.A.V.S.O. data. The average magnitudes at maximum and minimum are 7·39 and 11·94; the periods range from 161 to 219 days, with average time from minimum to maximum of 84 days. The spectrum varies from M2e (near maximum) to M6e, and the spectroscopic absolute magnitude at maximum is about −4·6. The star is thus the only regular long-period variable known to be a supergiant. Radiation measures by Pettit and Nicholson are used to compute the diameter (610 to 1 400 × sun) and temperature (3 000–2 010°K). D. L. E.

523.841.3 : 523.85 1781

Distribution of periods of cluster type variables in globular star clusters. SAWYER, H. B. *J. R. Astr. Soc. Can.*, **38**, 295–302 (*Sept.*, 1944).—Frequency curves of periods of cluster type variables are computed for each of 13 globular clusters in which the total number of such variables ranges from 7 to 168. The curves differ considerably from cluster to cluster but can be classified in two main groups (1) those with a single maximum frequency at periods of about 0·5 d., sometimes with a slight secondary maximum at about 0·3 d.; (2) those with two maxima, at about 0·35 d. and 0·65 d. D. L. E.

523.841.9 : 531.18 : 535.221 = 4 1782

Double stars and relativity theories. TIERCY, G. *Bull. Astr., Paris*, **12** (*No.* 2) 75–88 (1940) *In French.*—The hypothesis of the constancy of the velocity of light is abandoned. It is instead assumed that light is propagated in classical Euclidean space in a non-isotropic manner so that light-waves are ellipsoidal in form and centred on the source. Such a hypothesis is consistent with double-star observations—usually taken to indicate that the velocity of light is constant and isotropic. No reason is given for the postulated non-isotropic propagation. G. C. McV.

523.85 : 523.841.3 *see Abstr.* 1781

523.852.33 1783

Motions of the Magellanic Clouds. WILSON, R. E. *Publ. Astr. Soc. Pacif.*, **56**, 102–6 (*June*, 1944).—The radial velocities of 17 gaseous nebulae in the Large Magellanic Cloud and of one in the Small Magellanic Cloud are corrected for solar motion and used to calculate the space velocity of the Clouds and their direction of motion. It is found that essentially the same space motion is derived whether corrected or uncorrected radial velocities are used, a result due to the fact that the motion of the clouds is approximately perpendicular to the direction of motion of the sun in the Galaxy. The magnitude of the velocity deduced from the 18 nebulae is 554 ± 79 km/sec. It is probable that the two Clouds share the same motion. G. C. McV.

523.872–15 1784

Possibilities of astronomical spectroscopy in the infra-red. SWINGS, P. *Publ. Astr. Soc. Pacif.*, **56**, 220–9 (*Dec.*, 1944).—A discussion of the desirability of extending spectroscopic observations in the infra-red, and of future possibilities for such work of (1) sensitized photographic emulsions, (2) use of the Herschel effect, (3) evaporographic methods, (4) phosphorescent effects, (5) electron-image tubes. There is no hope of using photographic plates sensitive beyond 2μ. D. L. E.

523.873 1785

Absorption line intensities and spectral types for the O stars. PETRIE, R. M. *J. R. Astr. Soc. Can.*, **38**, 337–48 (*Oct.*, 1944).—Total absorptions of strong lines in small dispersion spectra show strong correlation with spectral type for O stars. Ratios of mean intensities for He I/He II, Si IV/He II and He II/H are finally adopted as criteria for accurate measured classification on H. H. Plaskett's system, and results agree with visual estimates by Pearce and E. G. Williams. No luminosity effects on line intensities are indicated by the measures. D. L. E.

523.877 1786

Note on the large-scale motion in viscous stars. SEN, N. R., AND GHOSH, N. L. *Bull. Calcutta Math. Soc.*, **37**, 141–52 (*Dec.*, 1945).—Randers' work on the rotation of stars [Abstr. 2012 (1941)] is further developed. Theorems are proved limiting the possible variations of the angular velocity. The internal circulations required to maintain certain internal distributions of angular velocity are determined. T. G. C.

523.893 = 4 1787

Comparison of photographic catalogues Bordeaux–Paris. SÉMIROT, M. P. *Bull. Astr., Paris*, **12** (*No.* 8) 381–9 (1946) *In French.*

523.991.2 1788

Occultations, their prediction, observation and reduction. BRYDON, H. B. *J. R. Astr. Soc. Can.*, **38**, 265–94 (*Sept.*); 321–36 (*Oct.*); 369–84 (*Nov.*); 417–30 (*Dec.*, 1944).

525.37 : 591.5 : 591.185.63 = 3 *see Abstr.* 2001

525.75 : 551.510.535 = 3 *see Abstr.* 1990

526.1 : 517.948 *see Abstr.* 1765

527 : 621.383 1789

A photo-electric sun compass for tanks. SPILSBURY, R. S. J., FELTON, A., AND PRESTON, J. S. *J. Sci. Instrum.*, **23**, 128–31 (*June*, 1946).—The compass is suitable for use on tanks in desert warfare, and is free from the limitations of magnetic compasses. Two photo-voltaic cells, connected in a balanced circuit, are arranged to form a 90° angle, with the bisector pointing, through an aperture, at the sun. A taut-suspension galvanometer gives an indication when the tank is off course by > about ½°. Methods of mechanical insulation are discussed, and a practical test at the highest speed of a Valentine tank is described.

PHYSICS 53

53.081 1790

On unities and dimensions. I–II. DORGELO, H. B., AND SCHOUTEN, J. A. *Proc. K. Ned. Akad. Wet.*, **49** (*No.* 2) 123–31; (*No.* 3) 282–91 (1946).—The absolute and relative dimensions of physical and geometric objects are discussed and the electromagnetic equations are written in a form independent of the choice of fundamental units. The general equations are specialized for each of the 4 usual systems, e.m.u., e.s.u., c.g.s. and M.K.S. Dimension formulae, independent of the choice of the fundamental units, are given and from these it follows that, using 8 fundamental units, it is always possible to give dimension formulae valid for every system. The field equations are made independent of the co-ordinate system and this leads to geometric representations of the vectors $\overline{E}$, $\overline{D}$, $\overline{H}$, $\overline{B}$ and to their absolute dimensions. $\overline{E}$ and $\overline{H}$ are the electric and magnetic field strengths. L. S. G.

53.081.5 : 621.3.011 = 4 1791

Electric and magnetic magnitudes. BRYLINSKI, E. *Rev. Gén. Élect.*, **52**, 121–5 (*April*, 1943) *In French.*—Objecting to fractional dimensions (e.g. charge in the normal electrostatic system features as $LT^{-1}\sqrt{(ML)}$, a new system is proposed avoiding mass but bringing in Q as a fundamental dimension. The dimensions of mass thus become Q^2L^{-1} in the electrostatic system. Complete electrostatic and electromagnetic dimensions on these lines are tabulated. G. F. F.

FUNDAMENTALS 530.1

530.12 : 530.145 = 4 1792

A principle connecting the theory of relativity and quantum theory. STUECKELBERG, E. C. G. *Helv. Phys. Acta*, **16** (*No.* 2) 173–202 (1943) *In French.*—It is shown that the two theories may be considered as a consequence of a single relativistic principle which is more general than that involving Lorentz covariance. The mathematics necessary for the applications of this principle is set up and the fields of Majorana, de Broglie, Dirac and Schrödinger–Yukawa are discussed. L. S. G.

530.14 : 535.14 = 4 *see Abstr.* 1837, 1838

530.14 : 537.122 1793

A discussion of the exactness of the Lorentz–Dirac classical equations. ELIEZER, C. J. *Bull. Calcutta Math. Soc.*, **37**, 125–30 (*Dec.*, 1945).—The equations [Abstr. 3660 (1938)] are used to investigate the motion of (1) a free electron, (2) an electron disturbed by a pulse, (3) an electron in the field of a charged thin infinite plate. The results all point to the suggestion that the equations are not exact. For in (1) there is a self-accelerating motion, in (2) the only allowable physical solution is artificial and in (3) there is no allowable physical solution. A suitable modification of the theory is briefly outlined. L. S. G.

530.145 : 517.22 = 4 *see Abstr.* 1762

530.145 : 530.12 = 4 *see Abstr.* 1792

530.145.6 = 4 1794

Study of the statistics associated with the operator $i\partial/\partial q$ by means of its characteristic function. ARNOUS, E. *C.R. Soc. Phys. Hist. Nat. Genève*, **62**, 64–6 (*April–July*, 1945) *In French.*—The ideas of a previous note [Abstr. 1795 (1946)] are used to show that the statistics associated with $i\partial/\partial q$ at the point X is the same as for q at the point $(2\pi)^{-\frac{1}{2}}LX$ where

$$LX = \int_{-\infty}^{\infty} e^{ixq} X(q) dq$$

The case where q varies over a finite range is also examined. L. S. G.

530.145.6 = 4 1795

Use of the characteristic function of Laplace in wave-mechanics for combining the principle of proper values and the principle of spectral decomposition into a single principle of quantization. ARNOUS, E. *C.R. Acad. Sci., Paris*, **218**, 108–9 (*Jan.* 17, 1944) *In French.*—The statistics associated with an operator A is defined by the totality of possible values of A and the corresponding probabilities. It may be represented by the distribution of unit mass on a line, and the distribution is represented by the characteristic function $K(u)$ where

$$K(u) = \int_D \psi^* e^{iuA} \psi dq$$

By expanding ψ in terms of the proper functions (ϕ), so that $\psi = \sum c_n \phi_n$ this may be written in the form $\sum |c_n|^2 e^{iua_n}$. To assert that this is the characteristic function of A implies (1) that the proper values a_i are the values A can take, (2) that the corresponding probabilities are $|c_n|^2$. It is possible to express the probabilities as functions of A and ψ only, by solving certain integral equations. L. S. G.

MECHANICS OF SOLIDS 531

531.012 : 534.01 = 4 *see Abstr.* 1824

531.18 : 535.221 : 523.841.9 = 4 *see Abstr.* 1782

531.19 : 511.2 1796

The analogy between the statistics of numbers and statistical mechanics. ORNSTEIN, L. S., AND MILATZ,

J. M. W. *Proc. Ned. Akad. Wet.*, **44** (*No.* 2) 163–72 (1941).—The theory of the Gibbs' ensemble is applied to some statistical problems in the theory of numbers, and a number of results are obtained which were previously derived by Borel, using a different method, e.g. it is shown that the majority of numbers in the continuum from zero to one is normal. L. S. G.

531.19 : 536.48 *see Abstr.* 1879

531.224.8 : 621.43.011 1797

Dynamic loading and some indications of its effect on internal combustion engines. CHAPMAN, C. W. *Proc. Instn Mech. Engrs, Lond.*, **153** (*War Emerg. Issue No.* 7) 221–36 (1945).—[Abstr. 1683 B (1946)].

531.259.2 1798

Some explicit formulae, of use in the calculation of arbitrarily loaded, thin-walled cylinders. BIEZENO, C. B., AND KOCH, J. J. *Proc. Ned. Akad. Wet.*, **44** (*No.* 5) 505–11 (1941).—The differential equations satisfied by the displacements of the middle-surface of the cylinder are written down and solved approximately. Expressions are then deduced for the internal forces and moments caused by the radial, tangential and axial loads. L. S. G.

531.261 : 521.12 = 4 *see Abstr.* 1775

MECHANICAL MEASUREMENTS 531.7

531.713 = 4 1799

Comparison of etalons of length. VOLET, C. *Rev. Opt. (Theor. Instrum.)* **21**, 168–75 (1942) *In French.*—Analyses the systematic errors liable to be encountered in the comparison of standard metres, etc., when observations are made on grooves or scratches. The effects of the shape of the groove and of the illumination are discussed. The method of comparison by means of reversible microscopes is advocated and a Société Genèvoise instrument of this type is described. A. H.

531.715.27 1800

The measurement of small linear motions by optical methods. HUNT, R. W. G. *J. Sci. Instrum.*, **23**, 119–21 (*June*, 1946).—Two optical methods for measuring small linear motions have been used, and some results obtained thereby are reproduced. The first makes use of two microscope objectives and depends on lenticular magnification for high sensitivity; the second uses a concave mirror and two prism systems, high sensitivity being obtained by means of prismatic magnification.

531.717 : 537.531 1801

Thickness measurement of thin coatings by X-ray absorption. FRIEDMAN, H., AND BIRKS, L. S. *Rev. Sci. Instrum.*, **17**, 99–101 (*March*, 1946).—The method is applicable to coating thicknesses in the range 10^{-5}–10^{-2} cm on crystalline bases. An X-ray source and a Geiger counter are both situated on the same side of the coating. The X-rays pass through the coating and are reflected at a Bragg diffraction angle from the base, back to the counter, their intensity being reduced by absorption due to the double transmission through the coating. The thickness of the coating is computed from the measured absorption.

531.717 : 545.81 1802

A method for determining small amounts of gold, and its use in ascertaining the thickness of electro-deposited gold coatings. CLABAUGH, W. S. *J. Res. Nat. Bur. Stand., Wash.*, **36**, 119–27 (*Feb.*, 1946).—A punch and die is used to obtain samples of known small area. Amounts of gold up to 10 micrograms (0·010 mg), corresponding to a thickness of 0·00050 mm or less on 1 mm² of surface, are determined directly by means of the colour produced with *o*-tolidine.

531.751.1 : 538.22 1803

Tests on highly non-magnetic stainless steels for use in the construction of weights. GOULD, F. A. *J. Sci. Instrum.*, **23**, 124–7 (*June*, 1946).—Tests have been made at the National Physical Laboratory on different types of stainless austenitic steel to ascertain to what extent they are non-magnetic. Several weights of the type (18% Cr, 8% Ni) used in Britain proved to be appreciably magnetic and a few were even found to be permanently magnetized to an appreciable extent upon receipt. Some other types of austenitic steel exhibited low permeability and retentivity, and rigorous tests, including severe cold rolling, were made on three promising types. So far as non-magnetic requirements are concerned, austenitic steel is available which is far superior to the 18/8 type and is even better than much commercial brass. Details of permeability and retentivity values are given.

531.764.5 : 621.317.39 1804

Quartz crystal clocks. SMITH, H. M. *Elect. Times*, **109**, 448–51 (*March* 28, 1946).—[Abstr. 1588 B (1946)].

531.782 : 620.172.087.45 1805

A fast stress-strain machine. DART, S. L., ANTHONY, R. L., AND WACK, P. E. *Rev. Sci. Instrum.*, **17**, 106–8 (*March*, 1946).—[Abstr. 1488 B (1946)].

531.787.9 1806

An instrument for determining the partial pressure of oxygen in a gas. PAULING, L., WOOD, R. E., AND STURDIVANT, J. H. *Science*, **103**, 338 (*March* 15, 1946).—The operation depends on the fact that oxygen has a much higher magnetic susceptibility than any other gas. The force on a test body surrounded by the gas in an inhomogeneous field is measured by means of a torsion balance. The precision depends on the range of pressures for which it is to be used, e.g. it is ±1 mm of Hg for a range 0–180 mm of Hg.

531.788.7 1807

A Pirani gauge for use at pressures up to 15 mm. RITTNER, E. S. *Rev. Sci. Instrum.*, **17**, 113–14 (*March* 1946).

531.788.7 : 621.396.615.029.3 : 533.5 *see Abstr.* 1821

531.792.2 1808

Equipment for producing divided circles at the Zeiss plant. *CIOS Rep.*, XXIX—59 (*H.M. Station. Off.*; *U.S. Dep. Comm.*) 5 *pp* (1946).—Describes the dividing machines in use; the main worm is driven by a gear shaped like an hour-glass, so that contact is made with several teeth at once, thus reducing the effect of irregularities in pitch. Two lines are traced with each ruling, so that each line on the finished product consists of a pair, very close together, thus eliminating some systematic errors. Photographic

methods were in the development stage. The capacity is 300–400 circles per month, with an error rarely exceeding 1·5 seconds of arc. N. C.

MECHANICS OF LIQUIDS 532

532.517 1809

Some considerations on the development of boundary layers in the case of flows having a rotational component. BURGERS, J. M. *Proc. Ned. Akad. Wet.*, **44** (*No.* 1) 13–25 (1941).—The influence of centrifugal forces upon the flow in boundary layers formed in parts of rotating pumps or ventilators is discussed mathematically. J. S. G. T.

532.517 : 591.112.3 *see Abstr.* 2000

532.517.4 1810

Theory of homogeneous isotropic turbulence. MILLIONSHTCHIKOV, M. D. *C.R. Acad. Sci., URSS*, **32** (*No.* 9) 615–18 (1941).—What is essential in the approximate method applied to the theory of homogeneous isotropic turbulence is that, at the stage when third moments are small and the laws of distribution approach normal, the fourth moments are connected approximately with the second by the same correlations that are strictly fulfilled for the normal law. These correlations, as well as Kármán's equations for the second and third moments, and the equation for the third and fourth moments, now obtained, form a closed system from which the third moments can be calculated. J. S. G. T.

532.517.4 1811

On the rôle of third moments in isotropic turbulence. MILLIONSHTCHIKOV, M. D. *C.R. Acad. Sci., URSS*, **32** (*No.* 9) 619–21 (1941).—The development of the theory of isotropic turbulence due to Kármán, Millionshtchikov and others is briefly traced. Following a previous paper [see Abstr. 1810 (1946)] it is shown that the larger the viscosity of a liquid, the wider the scope of a theory which neglects inertia terms, whereas an increase of the intensity of initial perturbations limits the applicability of such a theory. J. S. G. T.

532.517.4 1812

On velocity correlations and the solutions of the equations of turbulent fluctuation. CHOU, P. Y. *Quart. Appl. Math.*, **3**, 38–54 (*April*, 1945).—Three difficulties in the author's previous theory [Abstr. 1318 (1945)] are overcome. The pressure fluctuation is derived from the equations of turbulent fluctuation and is expressed as a function of the velocity fluctuation, the mean velocity inside the fluid volume and the pressure fluctuation on the boundary. The decay terms are also put into simpler forms. A general equation of vorticity decay for the determination of Taylor's scale of micro-turbulence is derived [Abstr. 4101 (1935)]. The turbulence problem may be reduced to a set of non-linear partial integro-differential equations. The difficulties arising in an attempt to solve these are discussed. The alternative method adopted is to solve the equations of turbulent fluctuation by setting up the differential equations satisfied by the velocity correlation functions of different orders. This method was initiated by Kármán and Howarth [Abstr. 457 (1938)]. Various applications of the theory of turbulence have been made [Abstr. 1813 (1946)]. L. S. G.

532.517.4 1813

Pressure flow of a turbulent fluid between two infinite parallel planes. CHOU, P. Y. *Quart. Appl. Math.*, **3**, 198–209 (*Oct.*, 1945).—A continuation of previous work [Abstr. 1812 (1946), 1318 (1945)]. The mean velocity distribution is found by two methods. The first is based upon the equations of mean motion and of double correlation. Good results are obtained in the theory of the spread of turbulent jets and wakes. The second method uses the equations of mean motion and both the equations of double and triple correlation by neglecting terms involving quadruple correlations. This is permissible to a first approximation in treating turbulent flow problems even though there is a wall present. The relation of the present theory to some known experimental data is discussed. L. S. G.

532.529 : 541.182.2.053 1814

Atomization. HARTMANN, J. *IngenVidensk. Skr.* (*No.* 1) 35 *pp.* (1942).—The mode of action of the Anderson paraffin atomizer and two modifications (Harag, Hjorth) used in connection with the Primus stove is investigated. The number and size of liquid particles was determined by collecting them on a falling lamp-blacked glass plate, a "spectrum" being produced by a transverse air blast. At an excess pressure of 0·5 atm about 25 000 drops of 0·11 mm dia. and 900 000 drops of 0·033 mm dia. were discharged per sec besides some extremely fine particles (7·5% of the whole mass of liquid). A series of photographs were taken of the liquid stream in a plexi-glass model, first with continuous and then with spark illumination. The latter shows that the liquid forms a surface layer on the walls of the tube, and the friction of the air stream against this layer generates waves which at higher pressure are lashed into spray. It seems that the main process of atomization thus occurs inside the mixing tube, although the action of the air on the emerging jet may contribute a perhaps undesirable portion, as shown by a further series of photographs. The hydrodynamic pressure distribution is analysed and the calculations are checked experimentally. A series of diagrams show good agreement between observed and calculated rate of air flux, for the Anderson and the Hjorth types. The hydrodynamical efficiency is defined as the mass of liquid atomized by unit mass of air. This ratio is 3 for the Anderson, 2 for the Hjorth type. J. A. W.

532.582.7 : 541.18 1815

Influence of the concentration of a suspension upon the sedimentation velocity (in particular for a suspension of spherical particles). BURGERS, J. M. *Proc. Ned. Akad. Wet.*, **44** (*No.* 9) 1045–51; (*No.* 10) 1177–84 (1941); **45** (*No.* 1) 9–16; (*No.* 2) 126–8 (1942).—The sedimentation velocity of a suspension is discussed mathematically, taking into account both the direct influence of gravity, and the velocity imparted to the liquid by fields of flow produced by all other sedimenting particles. Difficulties of the problem are associated with the fact that according to Stokes's equations, velocities produced at a point in an unlimited field by a moving particle decrease proportionally to the inverse first power of the distance

of the point; these difficulties are removed when a return flow in more distant parts of the flow field is automatically combined with the ordinary Stokes flow in the immediate neighbourhood of the particle. The results obtained are applied to deduce the effect upon a particle due to all surrounding particles in a field extending to infinity in all directions and having everywhere the same average concentration of particles. The effect of enclosure of the suspension between fixed plane parallel walls, or in a vessel of arbitrary form, is discussed. The latter case presents intractable difficulties. J. S. G. T.

532.583 1816

The pressure distribution on a body in shear flow. RICHARDSON, M. *Quart. Appl. Math.*, **3**, 175–8 (*July*, 1945).—A method is given for calculating the pressure distribution on an infinite cylindrical body immersed in a two-dimensional shear flow. It is an integral equation method and a direct attack on the boundary value problem for the stream function is avoided [see Abstr. 123, 146 (1945)]. An example is given, in which the contour of the cross section of the body is a circle. L. S. G.

532.694.1 1817

On the shape of froth chambers. BOK, S. T. *Proc. Ned. Akad. Wet.*, **43** (*No.* 9) 1180–90 (1940).—Observation of froth shows that (*a*) three films meet in slightly curved lines at angles of about 120° to one another, (*b*) four lines meet at a point at angles of about 109° to one another, and (*c*) the slightly curved faces of the froth cells usually have five edges, but occasionally four or six. (Where the froth is in contact with glass or water, the glass or water face of the cell is usually six-edged.) These observations show that froth cells cannot approximate to cubo-octahedra (Kelvin) or rhombic dodecahedra (Buffin), and point to the pentagonal dodecahedron as the ideal cell shape. This solid is approximately space-filling, and with the occasional appearance of faces with four or six edges can build up a froth of fairly regular cell size. Considerations of surface tension show that froth with perfectly flat faces cannot exist. A. J. C. W.

532.72 1818

A theory of membrane permeability. II. Diffusion in the presence of water-flow. BLOCH, I. *Bull. Math. Biophys.*, **8**, 21–8 (*March*, 1946).—The treatment of diffusion studied in a previous paper [Abstr. 517 (1945)] is extended to the case where water flows through the membrane in the direction from lower to higher concentrations of the solute. This water carries part of the solute by convection. If the net result is a flow of solute from lower to higher concentrations there is a negative value for the permeability. The effect of hydrostatic pressure is considered. L. S. G.

532.72 : 533.15 1819

Distinction between irregular and systematic motion in diffusion problems. BURGERS, J. M. *Proc. Ned. Akad. Wet.*, **44** (*No.* 4) 344–53 (1941).—Irregular motion is motion showing no preference for any particular direction: systematic motion is motion in which forces tend to drive the particles in a definite direction. The process of diffusion, involving as it does the transfer of matter from regions of high concentration to regions of low, is a statistical effect, conditioned by both types of motion. The distinction between irregular and systematic motions is of importance in problems such as the diffusion of liquids under gravity. Only when systematic motion is removed is it possible to correlate diffusion, irregular motion and concentration gradient in diffusion problems. A statistical theory of the diffusion process along these lines leads to the deduction of a diffusion equation in which no assumption is made concerning a mean free path of the moving particles. J. S. G. T.

532.72 : 533.15 : 536.2.02 *see Abstr.* 1876

532.72 = 3 1820

The theory of diffusion of binary mixtures and the interpretation of diffusion measurements. LAMM, O. *Ark. Kemi Min. Geol.*, **17 A** (*No.* 3) *Paper* 9, 21 *pp.* (1943) *In German.*—The theory is restricted to one-dimensional diffusion without volume change on mixing. If concentration is measured in moles/cm^3 the flow is represented by the differential equation $\partial n_2/\partial t = \partial(D\partial n_2/\partial x)/\partial x$ where n_2 is the concentration of the second component, and $D = RTN_1B_{12}/\Phi_2$ is the diffusion coefficient. Here N_1 is the mole fraction of the first component, Φ_2 is the "mutual friction" per unit volume, and B_{12} is an activity factor, defined as $\partial \log a_1/\partial \log N_1$, where a_1 is the activity of the first component. Diffusion experiments form a means of evaluating Φ_2 if the activities are otherwise measurable. A. J. C. W.

MECHANICS OF GASES 533

533.15 : 532.72 *see Abstr.* 1819

533.15 : 532.72 : 536.2.02 *see Abstr.* 1876

533.5 : 531.788.7 : 621.396.615.029.3 1821

Frequency modulated oscillator for leak hunting. BRUBAKER, W. M., AND WOUK, V. *Rev. Sci. Instrum.*, **17**, 97–8 (*March*, 1946).—A circuit for converting a variable d.c. voltage signal into a frequency modulation of an audio-oscillation is described. The circuit can be used for general monitoring purposes, but this article confines the description to its use in conjunction with an ionization gauge for leak hunting in vacuum systems. The oscillator enables one operator to hunt leaks more rapidly and effectively than two men calling out meter readings. Leaks representing pressure rises of less than 4×10^{-8} mm of Hg have been found with an ionization gauge and this oscillator.

533.5 = 4 1822

Large aperture vacuum-cock. GRIVET, P., AND BLATTMANN, H. *Le Vide*, **1**, 47 (*March*, 1946) *In French.*

533.6.013.4 : 512.52 *see Abstr.* 1757

533.6.071 1823

A method of calculating the wall correction for elliptic tunnels. GHATAGE, V. M. *Proc. Indian Acad. Sci. A*, **21**, 81–9 (*Feb.*, 1945).

ACOUSTICS . VIBRATIONS 534

534.01 : 531.012 = 4 1824

Kinematic definition of relaxation oscillations. ABELÉ, J. *C.R. Acad. Sci., Paris*, **220**, 511–13 (*April* 9); **221**, 656–8 (*Nov.* 26, 1945) *In French.*—A definition is given which is analogous to the well-known definition

of a simple harmonic oscillation as the projection of a point moving uniformly in a circle. This has certain advantages over the method of van der Pol who defined a relaxation oscillation by means of a non-linear second order differential equation. In the present method the parametric equations for a relaxation oscillation are $z = \cos\theta - f(\sin\theta)$, $\omega t = -\int_{\theta_0}^{\theta} (dz/d\theta)^{-1} \sin\theta d\theta$, where f is an arbitrary function. An example studied is $f = a\sin^3\theta$, which gives rise to an oscillation whose period varies from 2π to ∞ when $|a|$ varies from 0 to $\frac{2}{3}$. The second part discusses a discontinuous relaxation oscillation which is given (in the notation of the preceding part) by $f = a\sin^3\theta/|\sin\theta|$. L. S. G.

534.011/.012 : 550.341 1825

On surface waves in a stratified medium. I–II. SCHOLTE, J. G. *Proc. Ned. Akad. Wet.*, **45** (*No.* 4) 380–8; (*No.* 5) 449–56; (*No.* 6) 516–23 (1942).—Comprehensive theoretical study of the whole problem of all possible types of such waves: (1) If the incident wave, propagated in the underlying medium, is transverse and vibrates perpendicular to the plane of incidence, 4 transverse waves will occur: a reflected wave in this medium as well as a refracted and a reflected wave in the layer. (2) If it is longitudinal or transverse, vibrating in the plane of incidence, 7 waves occur: longitudinal and transverse reflected waves in the subjacent medium, as well as longitudinal and transverse refracted and reflected waves in the layer. The boundary conditions are derived. For an amplitude of the incident wave equal to zero, the equations of (1) lead to the Love wave-system, of (2) to the generalized Rayleigh- and Stoneley-waves. A new special case is obtained for the density of the underlying medium being equal to zero, which leads to the wave equation of an isolated layer, the properties of which are studied. The values of the material constants for which a generalized Rayleigh and Stoneley wave-system can exist are determined, also the general shape of the dispersion curves, representing the wave-velocity as a function of the wavelength. A. B.

534.015 : 517.91 1826

On the method of van der Pol and its application to non-linear control problems. BULGAKOV, B. V. *J. Franklin Inst.*, **241**, 31–54 (*Jan.*, 1946).—Approximate differential equations describing the behaviour of a mechanical or electrical non-linear oscillatory system with many degrees of freedom are constructed. These are non-linear, as are the exact equations, but they are more convenient for numerical integration. An example studied in detail relates to an automatically controlled system. The steady states of oscillation and the equations of transient motion in their vicinity are discussed. The stability of the vibrations is also treated. L. S. G.

534.22 1827

On the variation of the velocity of sound with the pressure of the gas. JHA, S. *Bull. Patna Sci. Coll. Phil. Soc.* (*No.* 13) 148–54 (*Jan.*, 1943).—The velocity of sound in a perfect gas $= (\gamma p/\rho)^{\frac{1}{2}}$ and for real gases this is multiplied by a factor ϕ. Expressions for this factor are derived from the virial equations of state proposed by Kamerlingh Onnes, and values of ϕ are tabulated for H_2, O_2 and C_2H_4 at 0°C. E. H. D.

534.231.3 1828

The driving-point impedance of an infinite solid plate. JONES, R. C. *J. Acoust. Soc. Amer.*, **17**, 334–6 (*April*, 1946).—In the design of mechanical filters whose function is to prevent the transmission of vibration from one structure to another, it is necessary to know the impedances of the structures between which the filter is to be connected. In many of the cases which arise in practice, the impedance may be estimated from a knowledge of the driving-point impedance of an infinite plate. The expression $8ph^2v$ is obtained for connection to a constant-thickness plate at a single point, where p is the density, h is the thickness of the plate, and v a velocity approximately equal to the velocity of shear waves in the material. This is equal, except for a constant factor, to the impedance of a mass equal to the mass of a disc cut from the plate whose radius is the mean proportional of the thickness and the wavelength which corresponds to v. The results are exemplified by applying them to the case of a steel plate.

534.321.6 1829

Toward a theory of intervals. IRVINE, D. B. *J. Acoust. Soc. Amer.*, **17**, 350–5 (*April*, 1946).—A study is made of the composite wave patterns, obtained by graphical means, of common two-tone intervals. Various aspects of the visual appearance of the patterns are discussed in relation to the question whether chords have individual "tone colours" analogous to the timbres of different instruments.

534.321.9 1830

Supersonic insects. PIELEMEIER, W. H. *J. Acoust. Soc. Amer.*, **17**, 337–8 (*April*, 1946).

534.642 1831

An apparatus for accurate measurement of the acoustic impedance of sound-absorbing materials. SCOTT, R. A. *Proc. Phys. Soc., Lond.*, **58**, 253–64 (*May*, 1946).—The acoustic impedance is measured at normal incidence by a stationary-wave method for frequencies in the range 100–5 000 c/s. From measurements made on a sample of material $1\frac{1}{4}$ in. in diameter, backed by a substantially rigid wall, the magnitudes of the resistive and reactive components of the impedance may be calculated with an accuracy of about 1%. The influence of the attenuation of sound associated with the walls of the tube in which the standing wave is formed is discussed, and it is shown that in addition to the correction which must be provided to the elementary expression for the "standing-wave ratio," the finite attenuation in the tube leads to an additional correction. Convenient methods for calculation of the results are described, and typical results are shown.

534.771 1832

Monitored live-voice as a test of auditory acuity. CARHART, R. *J. Acoust. Soc. Amer.*, **17**, 339–49 (*April*, 1946).

534.771 = 4 1833

Electro-acoustics and audiometry. CHAVASSE, P. *Bull. Soc. Franç. Élect.*, **2**, 341–62 (*Sept.*, 1942) *In French.*—The first part, dealing with the normal method of hearing, discusses the physiological and

physical conceptions of the threshold of hearing, the relation between the acoustic field and the excitation of the tympanum, measurement of the acoustic field and directional properties of the ears (as a pair) at different frequencies, and investigation of the threshold of audibility by means of telephonic listening. The second part deals with bone conduction, and gives a preliminary theoretical discussion of the transmission of vibrations into the bones of the head. The author discusses the various types of electrical and electromagnetic systems, e.g. modified E.M. telephone earpiece, quartz piezo-electric vibrator, and electrostatic microphone (designed to withstand high pressures of the order of a kg). [See *Akust. Z.* (March, 1939)].

A. B. W.

534.833.4 1834

Absorption and scattering by sound absorbent cylinders. Cook, R. K., and Chrzanowski, P. *J. Acoust. Soc. Amer.*, **17**, 315–25 (*April*, 1946).—The absorption and scattering of a plane wave of sound by an infinitely long circular cylinder, whose axis is perpendicular to the direction of propagation of the wave, are calculated, taking account of diffraction effects. Absorption measurements were made in a reverberation room, where the incident wave directions are at all angles, and compared with the calculated values. In order to make the comparison, the reverberation room statistics appropriate for cylinders are developed and applied. The measurements confirm that absorbent cylinders can have coefficients of absorption greater than unity. Fairly good agreement between the calculated and measured coefficients is found. The reverberation room statistics appropriate for spherical absorbers are also developed.

534.833.4 : 666.189.3 1835

Forms, properties and functions of fibrous glass acoustical materials. Rees, W. M. *Communications*, **26**, 36, 38 (*Jan.*, 1946).—Tabulates the sound absorption coefficients, for frequencies 128–4 096 c/s, of glass wool (fibre dia. 0·00005–0·00055 in) for thicknesses 1–3 in, densities 2–6 lb/ft³ faced with metal lath, perforated metal and muslin; and for glass-fibre-thermosetting-resin board 1 in thick for densities 2½–9 lb/ft³ bare, painted and covered with kraft paper. Mean absorption coefficient range 0·55–0·9. C. F. B.

534.845.1 1836

A small acoustical tube for measuring absorption of acoustical materials in auditoriums. Loye, D. P., and Morgan, R. L. *J. Acoust. Soc. Amer.*, **17**, 326–8 (*April*, 1946).—The tube is based on the principles described in Abstr. 665 B (1942) and is intended for the measurement of materials after they have been applied to the walls of auditoriums.

OPTICS . RADIATION . SPECTRA 535

535.14 : 530.14 = 4 1837

Remarks on the new theory of light. Bloch, L. *C.R. Acad. Sci., Paris*, **220**, 109–11 (1945) *In French.*—De Broglie has proposed a theory of light in which the photon is regarded as the result of the fusion of two "demi-photons," one of which satisfies Dirac's equation and the other the complementary equation. The result is that the demi-photons must be regarded as having masses equal but of opposite sign. The author points out that the same equations are obtained if axes of space and time with opposite signs are used in one equation as compared with the other. The case when the two equations represent the same particle is considered and shown to lead to the Maxwellian theory of the electromagnetic field.

G. C. McV.

535.14 : 530.14 = 4 1838

On an identity in the theory of the photon. Bloch, L. *C.R. Acad. Sci., Paris*, **220**, 240–1 (1945) *In French.*—The equation $\sigma_4 f_4 - \sigma_x f_x - \sigma_y f_y - \sigma_z f_z = 0$ has been verified by de Broglie in the case of the electron for a plane monochromatic wave. It is now shown that, in the case of the photon, f_x, σ_x, etc., must be replaced by $\frac{1}{2}(f_x{}^A B_4 + f_x{}^B A_4)$, $\frac{1}{2}(\sigma_x{}^A B_4 + \sigma_x{}^B A_4)$, etc., where A and B denote that de Broglie matrices must replace the Dirac matrices. G. C. McV.

535.215.1 : 535.733 : 621.383 1839

The electric eye *v.* the human eye. Sommer, W. *J. Televis. Soc.*, **4**, 150–70 (*Sept.*, 1945).—[Abstr. 1633 B (1946)].

535.215.1 : 621.383 = 3 1840

Transit time phenomena in photocells. Geest, H. *Hochfrequenztech. u. Elektroakust.*, **57**, 75–83 (*March*, 1941) *In German.*—[Abstr. 1632 B (1946)].

535.221 : 531.18 : 523.841.9 = 4 *see Abstr.* 1782

535.23.08 : 621.317.794 1841

Natural limit of measuring radiation with a bolometer. Milatz, J. M. W., and van der Velden, H. A. *Physica, 's Grav.*, **10**, 369–80 (*June*, 1943).—A theoretical discussion of the main causes of fluctuations in background, due to noise in amplifiers and resistances. Criteria are laid down for maximum sensitivity and for maximum signal-noise ratio. For small currents, the fluctuations in energy radiated to the bolometer become large. The work of Dahlke and Hettner, and Bauer, is discussed. N. C.

535.243 1842

A device to facilitate the reading of spectrophotometric curves. Reimann, G., and Carmine, E. J. *J. Opt. Soc. Amer.*, **36**, 235–6 (*April*, 1946).—A device which reduces eyestrain, caused by the many transverse and vertical movements of the eyes in the reading of spectrophotometric curves, is described. The spectrophotometric curve, the wavelength scale, and the reflectance scale are brought into controlled juxtaposition for reading. Means for magnifying the curve and related scales, setting the wavelength accurately and progressing quickly from point to point along the curve, are provided. The apparatus may be used with or without a wavelength correction and is applicable to either the selected or weighted ordinate method of reading.

535.245.24 : 628.921 1843

Light distribution from rectangular sources. Moon, P., and Spencer, D. E. *J. Franklin Inst.*, **241**, 195–225 (*March*, 1946).—The light distribution from rectangular sources of uniform and non-uniform brightness is calculated. The non-uniform sources represent windows lit by average overcast skies. Tables and graphs are presented which enable the pharosage (lumens/m²) to be calculated for surfaces at any point and tilted at any angle.

535.247 : 621.383.42 1844

Photometric equipment for blocking-layer light-sensitive cells. WROBEL, H. T., AND CHAMBERLAIN, H. H. *Gen. Elect. Rev.*, **49**, 25–9 (*April*, 1946).—[Abstr. 1634 B (1946)].

535.316.5 1845

Correction of imperfect weak cylindrical lenses. RANK, D. H. *J. Opt. Soc. Amer.*, **36**, 172–5 (*March*, 1946).—The use of cylindrical lenses as astigmatizers in range finders imposes severe conditions as regards quality. Some of these conditions are discussed and an interferometric testing process is described which is readily applicable to a wide range of focal lengths.

A. H.

535.317.6 1846

A system of transfer coefficients for use in the design of lens systems: VI. The chromatic variation of the tangential aberrations. CRUICKSHANK, F. D. *Proc. Phys. Soc., Lond.*, **58**, 296 302 (*May*, 1946).—[See Abstr. 2879 (1945)]. Using those differential transfer coefficients of a lens system which specify the rate of change of the tangential aberrations with the refractive indices of the component singlet lenses of the system, a simple method is available for the rapid calculation of the chromatic variation of these aberrations. In a similar manner, other transfer coefficients (the chromatic coefficients of the system) provide a rapid means of obtaining a complete analysis of the secondary spectrum of the system at any zone in the case of the axial aberration, and at any obliquity of the transverse aberration. Examples of an actual system are given.

535.33 : 537.531 *see Abstr.* 1899

535.33.03 1847

A new spectrographic spark source. BRAUDO, C., AND CLAYTON, H. R. *Nature, Lond.*, **157**, 622–3 (*May* 11, 1946).—Both high-voltage condensed spark and low-voltage controlled a.c. arc sources have been improved considerably in stability by the use of synchronized trigger circuits employing enclosed auxiliary spark gaps of the "Trigatron" type.

535.333 1848

Vibrational levels in the red CuO-bands. GUNTSCH, A. *Nature, Lond.*, **157**, 662–3 (*May* 18, 1946).—[See Abstr. 62 (1946)].

535.338.1 : 551.594.5 1849

The auroral spectrum. MITRA, S. K. *Nature, Lond.*, **157**, 692 (*May* 25, 1946).

535.338.334 1850

Pressure broadening of spectral lines. LINDHOLM, E. *Ark. Mat. Astr. Fys.*, **32 A** (*No.* 4) *Paper* 17, 18 *pp.* (1946).—Following Lenz [Abstr. 1892 (1933)] the broadening of spectral lines by foreign gases is treated by Fourier analysis of the emission frequency of the radiating atom. By neglecting the distribution of the molecular velocities of the gas it is possible to perform the Fourier analysis almost exactly. The expression thus obtained for the intensity distribution in the spectral line seems to be valid both in the core and wings and for both high and low pressures. This is proved by some special cases of the general formula where the theoretical distribution is known; for low pressures Lenz's intensity distribution formula is obtained, for high pressures Margenau's statistical formula [Abstr. 680 (1936)] and for the long wavelength side of the line Kuhn's [Abstr. 5026 (1934)] distribution. For the short wavelength side the intensity decrease $(\nu - \nu_0)^{-\frac{3}{2}}$ is obtained, which is contrary to earlier theories, but in good agreement with Minkowski's measurements [Abstr. 2100 (1935)].

535.338.334 1851

The broadening of Na lines by argon. KLEMAN, B., AND LINDHOLM, E. *Ark. Mat. Astr. Fys.*, **32 B** (*No.* 4) *Paper* 10, 9 *pp.* (1946).—A theory for the broadening of spectral lines by foreign gases, based on Fourier analysis of the electrical moment of the oscillator, indicates marked asymmetry in the line contours, and this is checked by new determinations of the contours of the yellow Na lines in the presence of A. Good agreement is obtained between the calculated and experimental values for the half-widths and the agreement as to the general shape of the lines is fairly good.

A. H.

535.338.4 1852

Bands in the copper arc. RAO, V. R. *Curr. Sci.*, **15**, 69–70 (*March*, 1946).

535.338.4 1853

Band systems in the spectrum of nitrogen. GAYDON, A. G., AND HERMAN, R. *Proc. Phys. Soc., Lond.*, **58**, 292–6 (*May*, 1946).—Several new band systems of N_2 which have been reported during the war [see Abstr. 880, 1079, 2144 (1944)] are compared, and agreement is generally satisfactory. There appear to be eight progressions of bands in the u.v. which are due to transitions to the $a^1\Pi$ state. Differing vibrational analyses for the Fifth Positive (Van der Ziel) system are discussed, and it is shown that Gaydon's interpretation is to be preferred, while for Kaplan's Second system Herman's vibrational analysis is more satisfactory. Bands in the green region are compared.

535.338.4 : 539.13 *see Abstr.* 1919

535.338.4–31 1854

Some new ultra-violet band systems of selenides and tellurides of tin and lead. SHARMA, D. *Nature, Lond.*, **157**, 663 (*May* 18, 1946).

535.34–15 : 545.82 *see Abstr.* 1961

535.343 1855

Electronic spectra of some bent triatomic molecules. DUCHESNE, J., AND ROSEN, B. *Nature, Lond.*, **157**, 692–3 (*May* 25, 1946).

535.343 : 537.531 *see Abstr.* 1900

535.343–15 = 3 1856

Infra-red absorption of aluminium oxide layers. FICHTER, R. *Helv. Phys. Acta*, **19** (*No.* 1) 21–40 (1946) *In German.*—The infra-red absorption spectra of anodically-produced oxide layers on pure (>99·99%) Al and on "Reflektal" (0·5% Mg) were investigated in the range 1–12 μ by means of a spectrometer already described [Abstr. 2335 (1941)]. Of 14 observed bands, 5 are assigned to O–H bonds and 4 to Al–O bonds. From the occurrence of the band at 1 600 cm^{-1} it is concluded that water is present as H_2O, not AlO(OH) or $Al(OH)_3$.

A. J. C. W.

535.343–32 1857

The absorption spectra of furfuraldehyde and benzaldehyde in the vacuum ultra-violet. WALSH, A. D. *Trans. Faraday Soc.*, **42**, 62–5 (*Jan.–Feb.*, 1946).—

Furfuraldehyde shows absorption in the region 2 000–1 700 Å and again below 1 600 Å. The bands below 1 600 Å are very similar to those of furan. This is in contrast to benzaldehyde, whose bands below 1 800 Å are similar not to the benzene spectrum but to the acrolein and acetaldehyde spectra. These benzaldehyde bands are due to the excitation of the $2p_y$ lone pair electrons on the oxygen atom. At longer wavelengths benzaldehyde shows absorption corresponding to the absorption regions found in benzene.

535.343.31 1858

The absorption spectrum of liquid oxygen. SMITH, H. D., AND BARTON, N. *Trans. Roy. Soc. Can.*, **39**, 25–31 (*May*, 1945).—Apparatus having been devised for obtaining long optical path lengths this was tried out on liquid oxygen, which has a number of known, well-defined absorption band systems. The region studied was from λ4200 to λ11500 and a longer path length was used than any previously recorded. Practically all of the bands previously recorded were observed, together with new bands at λλ10350, 9900 and 7060. Some of the bands were obtained photographically for the first time. A. H.

535.343.32 1859

The absorption spectrum of metal-ammonia solutions. OGG, R. A., JR. *J. Chem. Phys.*, **14**, 114–15 (*Feb.*, 1946).

535.343.4 : 541.141.7 1860

The dissociation spectra of covalent polyatomic molecules. SAMUEL, R. *Rev. Mod. Phys.*, **18**, 103–47 (*Jan.*, 1946).—An attempt is made to rationalize the continuous absorption spectra and some predissociation spectra of the vapours of a large number of covalent polyatomic molecules by correlating them with definite dissociation products. The experimental determination of dissociation energies from the long wave limit of continuous absorption is discussed in terms of the Franck–Condon principle and the forms of the potential energy curves. Atomic energies of formation of many molecules, derived thermochemically with Born's cycle, are tabulated. The long wave limits of continuous absorption are then listed and the photo-dissociation processes corresponding to the various regions of continuous absorption are examined in detail. The discussion is confined to molecules which are formed with a marked central atom, and it is found necessary to consider them in two classes, those in which the central atom exhibits a lower valency, and those in which it exhibits maximal valency. Bond energies are derived and tabulated. For the class of molecules with the central atom in a lower valence state the bond energies are approximately additive. When the central atom is in the maximal state of valency the atomic energy of formation cannot be calculated from bond energies of the corresponding molecules of lower valence states. The observations are explained better by the electron pair-bond theory than in terms of molecular orbitals. A. G. G.

535.343.4–31 1861

Near ultraviolet absorption of pyridine vapor. SPONER, H., AND STÜCKLEN, H. *J. Chem. Phys.*, **14**, 101–12 (*Feb.*, 1946).—The spectrum at 3 000–2 500 Å has been studied in the first order of a 3 m grating spectrograph. The band system represents an electronic transition $A_1 \rightarrow B_1$ (using symmetry C_{2v} for pyridine). Several progressions of totally symmetric vibrations are observed. The band 34 769 cm^{-1} is taken as 0,0 band. Besides carbon ring vibrations the occurrence of hydrogen vibrations is established and discussed.

535.343.4–32 1862

The absorption spectrum of glyoxal in the vacuum ultra-violet. WALSH, A. D. *Trans. Faraday Soc.*, **42**, 66–8 (*Jan.–Feb.*, 1946).

535.371 1863

Note on the behaviour of zinc sulphide phosphors under conditions of periodic excitation. LORD, M. P., AND REES, A. L. G. *Proc. Phys. Soc., Lond.*, **58**, 280–9 (*May*, 1946).—The behaviour of luminescent solids under conditions of periodic excitation is discussed theoretically and predictions made on the basis of simple models for the electronic processes. The significant features are the shift in phase with respect to the exciting radiation and the ratio of maximum to minimum emitted intensities. The variation of these parameters with intensity and period of excitation can be used to distinguish between various mechanisms for the luminescence process. Experiments are described, using a c.r.o. technique, illustrating the application of the method to ZnS and Zn,CdS phosphors. The general conclusions are that these phosphors do not possess any of the characteristics associated with the monomolecular mechanism, but show a semi-quantitative agreement with the requirements of a simple ionization-recombination mechanism. Deviations from theory are ascribed to the complexity of these phosphors, which are activated by more than one type of activator atom.

535.371 : 535.89 1864

Note on the rapid determination of decay characteristics of luminescent solids. LORD, M. P., AND REES, A. L. G. *Proc. Phys. Soc., Lond.*, **58**, 289–91 (*May*, 1946).—The possibility of producing square-wave light pulses from a gaseous discharge has been investigated. Decay curves sufficiently accurate for the estimation of half-life periods and for the study of gross effects could be obtained by interrupting the d.c. supply to the discharge by means of a small vibrator.

535.375.54 1865

Raman effect in rock-salt. KRISHNAN, R. S. *Nature, Lond.*, **157**, 623 (*May* 11, 1946).—[See Abstr. 73 (1946)].

535.375.55 1866

A number of Raman spectra of isotope molecules. DE HEMPTINNE, M. *Trans. Faraday Soc.*, **42**, 5–9 (*Jan.–Feb.*, 1946).—The Raman spectra of deutero-substituted methyl chloride, bromide, iodide and methyl alcohol were measured. The Raman spectra of vinyl bromide and vinylidene bromide and of their deutero derivatives were also determined. In the case of vinylidene bromide it was possible to make an unambiguous assignment of the measured frequencies to all the fundamental modes of vibration, both planar and non-planar.

535.39 : 535.81 = 4 1867

Reduction of the reflecting power of optical surfaces. JACQUINOT, P. *Rev. Opt.* (*Théor. Instrum.*) **21**, 15–37

(1942) *In French.*—Surveys the various methods available for reducing the loss of light by reflection in optical instruments. Full details are given of the evaporation, chemical and soap film methods of treatment and of the improvement effected by each method. The underlying theory is given. A section is devoted to the converse problem, the improvement in reflecting power obtainable by means of deposited layers. A. H.

535.417 1868

Asymmetrical broadening with multiple-beam interference fringes. BROSSEL, J. *Nature, Lond.*, **157**, 623 (*May* 11, 1946).—When using multiple-beam Fizeau fringes of equal thickness for the study of surface topography [see Abstr. 609 (1946)] it is necessary to know which parts of the fringe system represent a projection or depression on the surface. By using a slightly extended source in place of a pinhole, the fringes spread asymmetrically towards the region of greater air-film thickness. The increase of intensity enables measurements to be made on the sharp side of the fringe with precision nearly equal to the narrow fringes.

535.417 : 536.55 : 537.525 *see Abstr.* 1895

535.421 1869

The diffraction of light by an assembly of opaque circular disks. KATHAVATE, Y. V. *Proc. Indian Acad. Sci. A*, **21**, 233–9 (*May*, 1945).—The Fraunhofer diffraction pattern of an assembly of artificially prepared small opaque circular discs of identical size was investigated experimentally. The diffraction pattern underwent a series of changes as the distribution of the discs was altered. Striking optical analogies are presented to various well-known X-ray and electron diffraction effects. Twelve photographs of the diffraction patterns taken in monochromatic light and six in white light are reproduced, with the corresponding distributions.

535.421 : 548.735 *see Abstr.* 1971

535.422 1870

On the radiation from the boundary of diffracting apertures and obstacles. RAMACHANDRAN, G. N. *Proc. Indian Acad. Sci. A*, **21**, 165–76 (*April*, 1945).—Neglecting the obliquity factor, it is shown that the surface integral usually employed for the determination of the disturbance at any point can be easily converted into a line integral along the boundary of the diffracting screen. The illumination in the region of shadow can be completely represented as the effect of radiations arising from the boundary, while in the region of light the direct light is superposed on this. The boundary radiation can again be effectively replaced by the radiations arising from a finite number of point-sources situated on the boundary called "poles" for which the path to the observation point is a max. or a min. The phase of the resultant disturbance due to regions of the boundary including and lying on either side of a pole is shown to lead or lag behind that of the wave from the pole by $\pi/4$, according as the pole is one of max. or min. path. Applying these ideas to the diffraction pattern of a circular disc, it is shown that the calculated radii of the rings in the region of shadow agree well with those deduced from Lommel's theory.

535.422 1871

Geometric theory of Fresnel diffraction patterns. I–VI. KATHAVATE, Y. V. *Proc. Indian Acad. Sci. A*, **21**, 177–210 (*April*, 1945).—Using the methods described in Abstr. 1870 (1946) the diffraction patterns of obstacles and boundaries in the form of circles, rectangles, triangles, sectors of circles, and ellipses are explained, photographs of the patterns being used for illustration. The transition from the Fresnel to the Fraunhofer class as the size of the aperture diminishes is also illustrated.

535.516 = 4 1872

Liquid Fresnel rhomb. DE MALLEMANN, R. *Rev. Opt. (Théor. Instrum.)* **21**, 46–7 (1942) *In French.*—Details are given of a Fresnel rhomb of which the base and sides are of glass in a brass frame, the hollow rhomb thus formed being filled with chlorobenzene ($n = 1{\cdot}51$). The dimensions are 125 mm × 50 mm × 25 mm, $\alpha = 51°$. A. H.

535.733 : 621.383 : 535.215.1 *see Abstr.* 1839

535.81 = 4 1873

A method for the study of optical defects in glass. ARNULF, A. *Comm. Lab. Inst. Opt. Paris*, 100–4 (*Dec.*, 1944) *In French.*—Optical defects may be caused by surface irregularities or inhomogeneity of the glass, and have the same effect as long focus lenses. This method consists of finding the image of a luminous point source formed by such lenses and a good quality concave mirror. A large area of glass may be examined rapidly, and the method is suitable for industrial use. N. C.

535.81 = 4 1874

Principles of a method of checking the optical quality of plate glass. ARNULF, A. *Comm. Lab. Inst. Opt. Paris*, 105–19 (*Dec.*, 1944) *In French.*—Discusses the need for avoiding optical defects in plate glass, and describes the two chief methods used for measuring these defects. These methods are due to Seidel and to Rouchi-Lemouvel. The tolerances are given, to which the glass must be made in order that no disturbance to vision shall ensue. N. C.

535.81 : 535.39 = 4 *see Abstr.* 1867

535.89 : 535.371 *see Abstr.* 1864

535.89 = 4 1875

Possibility of employment of Hg lamp as stable monochromatic source. BLET, G. *Rev. Opt. (Théor. Instrum.)* **21**, 65–70 (1942) *In French.*—The influence of variations of voltage and frequency on the intensity of the various radiations emitted by a Hg high pressure lamp (type, Philips H.P.-300) are studied, the radiations being isolated by means of filters and measured by Se cells. It is concluded that the lamp can be used as a stable source of monochromatic light but that for the flux to be maintained constant to 0·5% the voltage and frequency must be maintained constant to 0·1%. A. H.

HEAT . THERMODYNAMICS 536

536.2.02 : 532.72 : 533.15 1876

Measurement of diffusion and thermal conductivity "constants" in non-homogeneous media, and in media where these "constants" depend respectively on concentration or temperature. BARRER, R. M. *Proc.*

Phys. Soc., Lond., **58**, 321–31 (*May*, 1946).—Equations have been derived for the steady state distributions of temperature or concentration across membranes in the form of plates, tubes or spherical shells, when the thermal conductivity, or diffusion, "constants" are functions respectively of temperature, or solute concentration, in the diffusion medium, and also where these "constants" are functions of the positional co-ordinates. Equations are similarly given for the quantity of heat or solute transported through the membranes. Procedures based on these equations are given for measuring diffusion and thermal conductivity "constants" and their dependence upon concentration and temperature respectively, or on positional co-ordinates. All observational data are based only on the steady state of flow. The methods are suitable for measurements of flow of liquids, vapours or dyestuffs through natural and artificial plastics, of gases and liquids through zeolitic media, in surface migration of adatoms on metals and similar problems.

536.33.08 : 615.831 1877

The application of the unit sphere method to the computation of radiant-heat flux for medical purposes. EVANS, D. S. *J. Sci. Instrum.*, **23**, 98–101 (*May*, 1946).—Investigations on the radiant-heat flux administered to patients by various types of clinical device led to the need for calculation of dosage. Calculation by ordinary methods is often tedious and complicated, but because the extended sources, such as "reflectors" and screens, which supply the greater part of the radiation are at a uniform temperature, it is possible to apply the unit-sphere method to the calculation of the fluxes for which they are responsible. The method is applied in its graphical form to the case of the standard radiant heat cradle, and an optical device is described by which the same results can be obtained more readily. The interpretation of the shadowgrams produced by this device is discussed.

536.413 : 536.763/.764 : 541.57 : 548.73 *see Abstr.* 1967

536.422.1 = 3 1878

The vaporization speed of ice. TSCHUDIN, K. *Helv. Phys. Acta.*, **19** (*No.* 2) 91–102 (1946) *In German.*—The speed of vaporization of a film of ice at different temperatures in vacuum was measured with an electrical balance, the surface temperature being measured with a fine thermo-element. From this the evaporation coefficient can be calculated by applying the formula for the maximum evaporation velocity obtained from gas kinetic theory. Between −85 and −60°C, the value was 0·94, independent of temperature, which is close to the theoretical value of 1. By comparison, the experimental value for the liquid phase is only 0·04.

536.48 : 531.19 1879

Mendelssohn's z-particles and the Bose–Einstein statistics. BAND, W. *Proc. Phys. Soc., Lond.*, **58**, 302–5 (*May*, 1946).—Bose–Einstein statistics are applied to Mendelssohn's *z*-particles [see Abstr. 3016 (1945)] and shown to give a satisfactory qualitative explanation of the phenomena of liquid He.

536.514 1880

A simple carbon dioxide vapor pressure thermometer. ANDERSEN, H. C. *Rev. Sci. Instrum.*, **17**, 112–13 (*March*, 1946).

536.532 : 536.581 1881

A "cold-junction" box for thermocouples. BASTINGS, L. *J. Sci. Instrum.*, **23**, 132 (*June*, 1946).

536.532 : 621.394.645.3 : 621.314.12 = 3 1882

Amplifier for thermo-electric voltages. HANDRICK, E. *Elektrotech. Z.* [*ETZ*] **62**, 193–6 (*Feb.* 27, 1941) *In German.*—[Abstr. 1528 B (1946)].

536.532.088.6 1883

A graphical determination of unshielded-thermocouple thermal correction. ROHSENOW, W. M. *Trans. Amer. Soc. Mech. Engrs*, **68**, 195–8 (*April*, 1946).

536.55 : 535.417 : 537.525 *see Abstr.* 1895

536.581 : 536.532 *see Abstr.* 1881

536.62.088 1884

Heat capacity of a two-phase system, with applications to vapor corrections in calorimetry. HOGE, H. J. *J. Res. Nat. Bur. Stand., Wash.*, **36**, 111–18 (*Feb.*, 1946).—A formula is derived that gives the heat capacity of a system composed of solid or liquid in equilibrium with saturated vapour in terms of the specific heat of the condensed phase and certain auxiliary data. This formula is valid throughout the entire range 0–100% of vapour, and at the latter extreme reduces to a well-known relation between the specific heats of saturated liquid and saturated vapour. The advantage of the formula lies in the fact that the vapour correction in calorimetry is expressed as a single term that may be readily transformed with Clapeyron's equation, yielding two alternative correction formulae. Vapour corrections to the heat capacity and to the heat of fusion are summarized and tabulated for four different experimental procedures in calorimetry.

536.666 : 669.715.3 1885

Evolution of heat during the precipitation in aluminium–copper alloys at 225°C. BORELIUS, G., AND STRÖM, L. *Ark. Mat. Astr. Fys.*, **32 A** (*No.* 4) *Paper* 21, 10 *pp.* (1946).—[See Abstr. 1112 (1944)]. Both the energy released and the relative rate of release increase with Cu content. The total energy released is 43 cal/gm atom for 2% by weight Cu, 47 for 2·5%, 75 for 3·5% and 111 for 4·5%. From the initial rates of release it is estimated that the minimum size of a stable nucleus at this temperature is about 390 atoms. A. J. C. W.

536.7 1886

Thermodynamics and the logarithmic temperature scale. DONALD, M. B. *Nature, Lond.*, **157**, 624–5 (*May* 11, 1946).

536.763/.764 : 541.57 : 536.413 : 548.73 *see Abstr.* 1967

ELECTRICITY . MAGNETISM . X-RAYS CHARGED PARTICLES 537/538

537.122 : 530.14 *see Abstr.* 1793

537.123 : 537.591 1887

Some experimental results concerning mesotrons. SHUTT, R. P. *Phys. Rev.*, **69**, 261–74 (*April* 1 *and* 15, 1946).—In the first part of the article cross sections for anomalous, non-Coulombian single scattering of

mesotrons are determined by a comparison of the scattering observed in two different lead thicknesses, a method partly described in a previous paper [Abstr. 1332 (1942)]. For mesotrons with energies above $\sim 5 \times 10^8$ eV it is found that the scattering through angles ranging from less than 5° up to 90° is predominantly anomalous. The second section concerns itself with showers of mesotrons. The phenomenon of saturation for the production of mesotron showers in lead as reported by Jánossy and Sinha is not confirmed. Some special photographs of mesotron and electron showers are reproduced and discussed. In the last section an analysis of the number of slow, heavily ionizing mesotrons and protons gives only slight and not conclusive evidence that mesotrons of very low energies (<20 eMV) disappear by a process other than any known so far.

537.222:537.565 = 4 1888

The physics of an electro-aerodynamic phenomenon. YADOFF, O. *Bull. Soc. Franç. Élect.*, **1**, 443–57 (*Aug.–Oct.*, 1941) *In French.*—An insulated charged body will lose its charge at a rate dependent on the characteristics of the surrounding air. In stagnant air the rate is detectable but very small, while at an air velocity of 385 m/s the rate of loss of charge for a 35 mm diameter sphere becomes appreciable. A speed of 410 m/s can be considered as the limiting speed separating the barely detectable from the easily detectable rates. This speed corresponds to the value above which air cannot be considered to be incompressible. Probability theory leads to an exponential law for the rate of loss of charge and a loss coefficient is expressed in terms of humidity, absolute temperature, pressure and degree of ionization of the air. Irradiation with u.v. light increases the rate. A similar formula is deduced from Townsend's theory of ionization by collision. The physical system which develops is explained in terms of the movement of charges which, on the surface of a sphere, form an air condenser, as an oppositely charged layer forms on the outer surface of a stagnant air layer round the sphere. Movement of the surface charges and of the ions in the air are responsible for the discharge of the sphere. E. H. D.

537.226 : 621.315.613 1889

High titania dielectrics. WAINER, E. *Trans. Electrochem. Soc.*, **89** (*Prepr. No.* 3) 25 *pp.* (1946).—[Abstr. 1546 B (1946)].

537.226.8 1890

The change in the dielectric constant of liquids due to flow and the effect of a direct electric field on the same. PRASAD, S. P., SINGH, B. N., AND SINGH, B. D. *Bull. Patna. Sci. Coll. Phil. Soc.* (*No.* 13) 107–15 (*Jan.*, 1943).—Certain dielectric liquids are found to give a decrease in their h.f. dielectric constant when they are in motion between the electrodes, the effect becoming larger as the electrode separation is decreased. The effect is less if a steady field is superimposed. With a plate separation of 0·005 cm the changes observed are of the order of 23×10^{-4} to $9{\cdot}9 \times 10^{-4}$ for d.c. fields of 0 to 24 kV/cm. An explanation, based on the assumption that the liquids' molecules are oriented in a layer adjacent to the electrode surfaces, is given. A. M. T.

537.228.1 : 539.31 : 548.0 = 3 *see Abstr.* 1962

537.311.1 = 3 1891

On the theory of the retardation of the fast charged particles in metallic conductors. KRONIG, R., AND KORRINGA, J. *Physica, 's Grav.*, **10**, 406–18 (*June*, 1943) *In German.*—The theory of metals, as developed by Sommerfeld, Bloch and others, leads in the first instance to an infinite contribution of the conduction electrons to the energy losses of fast charged particles traversing a metal. In contrast to v. Weizsäcker, who showed that upon considering the energy transfer from the conduction electrons to the metallic ions the energy losses become finite, their limitation can be ascribed to the mutual interaction of the conduction electrons, inadequately taken into account in the theories mentioned. Treating the conduction electrons as a negatively charged fluid by hydrodynamic methods, a formula for the energy losses can be derived in harmony with experimental facts. It appears that the friction of the negative fluid with respect to the positive substratum of the metallic ions, which is the cause of ohmic resistance, is of no importance in the discussion of these energy losses, but that they are almost entirely due to the internal friction of the negative fluid. The coefficient of internal friction is estimated from the empirical data in the case of Li and found to agree with the theory.

537.311.35 1892

The conduction process in dilute metal-ammonia solutions. OGG, R. A., JR. *J. Chem. Phys.*, **13**, 533 (*Nov.*, 1945).—Very dilute solutions of Na and K (10^{-4}–10^{-3}M) in liquid NH_3 have been found to have high electrical conductivities when cooled to temperatures in the range from the freezing point of NH_3 to −180°C. The conductivity seems to be too high to attribute to ionic transport, but is likely to be due to "metallic" free electrons [See Abstr. 1894, 1950 (1946)].

537.311.4 = 3 1893

Technical physics of electrical contacts. HOLM, R. *Elektrotech. Z.* [*ETZ*] **62**, 633–7 (*July* 17, 1941) *In German.*—Absolutely clean metallic surfaces can only be established and maintained in a vacuum, and when such surfaces are pressed together, effective contact is limited to isolated spots. In air, metallic surfaces are covered with a film of oxides, chlorides, etc., and usually lubricated. The effects of these phenomena on contact resistance, the narrowing of the current path and the breakdown of the surface film, are discussed. Reference is made to the breakdown of thicker films (coherer resistance), and contact pressure, deformation of surface, heating effects, and sliding contact, are discussed. J. A. W.

537.312.5 : 541.133 *see Abstr.* 1950

537.312.62 1894

Bose–Einstein condensation of trapped electron pairs. Phase separation and super-conductivity of metal-ammonia solutions. OGG, R. A., JR. *Phys. Rev.*, **69**, 243–4 (*March* 1 *and* 15), *Erratum*, 544 (*May* 1 *and* 15, 1946).—Rapid freezing of certain concentrations of dilute solutions of alkali metals in ammonia which normally separate on cooling into two dilute liquid phases has been found to produce very high conductivity. By an adaptation of Kamerlingh Onnes "ring" experiment, these solid solutions have been found to be, in fact, supra-

conducting. The probable explanation is to be found in the behaviour of trapped electron pairs [see Abstr. 1859 (1946)] with Bose–Einstein characteristics, which are formed by the rapid cooling preventing the liquid-liquid phase separation. The phenomenon is discussed with reference to previously observed supraconductivity [See Abstr. 1892, 1950 (1946)].

537.523.4 : 621.316.933 : 551.594.221 = 3
see Abstr. 1998

537.525 : 536.55 : 535.417 1895

A method for measuring the temperature in a discharge with the aid of Jamin's interferometer. MILATZ, J. M. W., VREEDENBERG, H. A., AND BRAAK, J. W. *Physica, 's Grav.*, **10**, 433–9 (*June*, 1943).—The radial distribution of the temperature in the positive column of a discharge can be determined by measuring the displacement of the fringes. This effect is so large that one can easily see the movement of the fringes caused by varying the current in the discharge-tube. It is shown that the influence of curvature of the rays may be neglected. Some provisional results are compared with those of other methods. The method is very accurate.

537.525 = 3 1896

New investigations on the cathode sputtering of the glow discharge. V. The nature of the surface of the cathode. GÜNTHERSCHULZE, A., AND TOLLMIEN, W. *Z. Phys.*, **119** (*Nos.* 11–12) 685–95 (1942) *In German.*—Maintaining the cathode of a glow discharge at room temperature, the surface obtained by cathode sputtering consists of sub-microscopical, closely packed, equiangular, upright cones. The angles of the cones are characteristic of the metals used. They were measured and their dependence on the variables involved determined. With Au, Fe, Ni, Pt the effect is absent; with Ag and Cu it is moderate; with Mg, Cd, Zn, Al, Sn, Pb, Sb, Bi it is strongly marked. The speed of sputtering drops the more rapid the formation of the cones. The relationship between the speed of sputtering and the size of the angle of the cone was calculated and found experimentally. Experiment and calculations are in good agreement. [See Abstr. 1167 (1944)]. H. G. S.

537.525 : 621.3.011.2 = 3 1897

Impedance measurements on gas discharge tubes. VERHAGEN, C. J. D. M. *Physica, 's Grav.*, **8**, 361–76 (*March*, 1941) *In German.*—Van Geel's theory of electrical discharges in gases [Abstr. 3740 (1939)] is explained and discussed. The conception of the "self-inductance of a discharge" is introduced, and its variation with frequency considered. Good experimental confirmation is obtained by means of a Wagner a.c. bridge and oscilloscope as an indicator. A. L.

537.525.5 1898

Ozone production by low-pressure mercury arcs. KOLLER, L. R. *Gen. Elect. Rev.*, **49**, 50–3 (*April*, 1946).—Describes a method of measurement of ozone concentrations by observing the absorption of 2 537 Å radiation from a mercury lamp. This apparatus is used to study the rate of production of ozone and the equilibrium concentrations under various conditions of temperature, humidity and pressure. N. C.

537.531 : 531.717 *see Abstr.* 1801

537.531 : 535.33 1899

Structure in the X-ray *K* absorption edge of metallic potassium. PLATT, J. B. *Phys. Rev.*, **69**, 337–46 (*April* 1 *and* 15, 1946).—For Na and K the free electron approximation should give the energy states in the conduction band closely. Calculations based on this approximation predict an arctan shape for the potassium *K* absorption edge which has been explored with high resolving power. Experimental details are given. The shape and width of the edge agree with the predicted values. Some evidence is found of a secondary structure not given by the simple theory and the free electron approximation. The wavelength of the midpoint of the edge has been redetermined to be $3\,428{\cdot}8 \pm 0{\cdot}2$ XU.

537.531 : 535.343 1900

The fine structure of the *L*-absorption edges of tungsten and tantalum and the electronic conduction band of these elements. COSTER, D., AND BRIL, A. *Physica, 's Grav.*, **10**, 391–405 (*June*, 1943).—Details are given of the experimental observations made on the fine structure of the various L-absorption edges of Ta and W, these being found in some cases to be identical. The results are applied to the determination of the outer electronic states for the lattice of tungsten. A. H.

537.533.8 1901

Saddle-point methods in the cascade theory. JÁNOSSY, L., AND TZU, H.-Y. *Nature, Lond.*, **157**, 624 (*May* 11, 1946).—The error involved in the usual methods of integrating Landau and Rumer's expression [see Abstr. 2424 (1938)] is shown to be small, even when the thickness of the collision layer is small.

537.56.08 1902

Use of the linear amplifier for the measurement of the ionization by single particles. WYTZES, S. A., AND VAN DER MAAS, G. J. *Physica, 's Grav.*, **10**, 419–32 (*June*, 1943).—The use of the linear amplifier has been examined with special reference to the condition that the recorded deflection should be proportional to the number of ions. Formulae are deduced connecting the number of ions produced by a single particle and the deflection of the oscillograph. A. J. M.

537.562 1903

Townsend's ionization coefficients for neon, argon, krypton, and xenon. KRUITHOF, A. A. *Physica, 's Grav.*, **7**, 519–40 (*June*, 1940).—The ionization coefficient has been determined for Kr and Xe. For $E/p_0 < 40$ V/cm/mm Hg the ionization decreases in the order Ne, A, Kr, Xe. The number, γ, of additional electrons liberated per positive ion striking the cathode depends strongly on the nature of the cathode. γ was determined for A with three different Cu cathodes. The general form of γ shows that it can be regarded as composed of two parts, one due to electrons emitted by collisions of positive ions, and the other due to electrons liberated by the photo-electric effect of radiation in the extreme ultra-violet. For high values of E/p_0 the former predominates. A. J. M.

537.564 : 539.181 1904

The ionization of helium by neutral helium atoms. HORTON, F., AND MILLEST, D. M. *Proc. Roy. Soc. A*, **185**, 381–98 (*April* 5, 1946).—Apparatus and experiments are described for investigating ionization in He by collisions between quasi-stationary atoms (pos-

sessing only thermal velocities) and a beam of neutral He atoms with kinetic energy less than 100 eV. The mean value obtained for the activation energy is 49·4 eV, which is considerably smaller than the values obtained in earlier investigations [Abstr. 3799 (1936), 835 (1935), 3147 (1933)]. The latter are discussed and compared with the present value. Ionization begins when the kinetic energy of the bombarding atoms is about twice as great as the minimum kinetic energy which electrons must have in order to ionize He.

L. S. G.

537.565 : 537.222.5 = 4 *see Abstr.* 1888

537.568 : 541.124.7 1905

Metastable ions formed by electron impact in hydrocarbon gases. HIPPLE, J. A., FOX, R. E., AND CONDON, E. U. *Phys. Rev.*, **69**, 347–56 (*April* 1 *and* 15, 1946).—The non-integral masses appearing in the mass spectra of various hydrocarbons may be explained by spontaneous dissociation of some of the ions after acceleration. By means of an energy filter, an energy analysis of the non-integral masses in *n*-butane, butadiene, and ethane has been made and the values obtained agree with those predicted on the basis that they arise from metastable ions. Variation of the pressure and electrode potentials confirms that the dissociation is spontaneous. The formation of metastable ions appears to be a general occurrence in the ionization and dissociation of hydrocarbons and is shown here to occur in ethane, propane, 1,3-butadiene, butene-1, *cis*-butene-2, isobutylene, normal butane, iso-butane, pentene-2, normal pentane, iso-pentane, and methyl-cyclo-pentane.

537.591 1906

On the production of mesotrons by neutral particles. GILL, P. S., AND RAM, M. *Indian J. Phys.*, **19**, 71–4 (*June*, 1945).—Experiments of the type of Abstr. 2111 (1940) performed at 16 800 ft at Bara Lacha (22.5°N) show that the production of mesotrons by non-ionizing cosmic rays does not become noticeable at these heights in intermediate latitudes as it does around the latitude of Chicago, i.e. the mesotron producing layer in the atmosphere is at greater height in the equatorial regions.

537.591 : 537.123 *see Abstr.* 1887

537.591 : 621.318.57 = 4 1907

Counting and selection of cosmic rays. MAZE, R. *Ann. Phys., Paris*, **15**, 59–142 (*Jan.–March*, 1941) *In French.*—[Abstr. 1603 B (1946)].

537.591.15 1908

Cascade showers and mesotron-produced secondaries in lead. NASSAR, S., AND HAZEN, W. E. *Phys. Rev.*, **69**, 298–305 (*April* 1 *and* 15, 1946).—The cloud chamber used for the observations contained four Pb plates and was placed in an 1 100-gauss magnetic field. In the case of showers, comparison with theory was made in terms of: (*a*) the average shower curve for 11 showers with initiating energies of about 200 eMV; (*b*) the energy distribution near the shower maximum of 17 showers; (*c*) the ratio of height to area of the shower curve of 44 showers; and (*d*) the fluctuation in number of particles in the showers of (*a*). The theory agrees with experiment for (*b*) and (*d*) but not for (*a*) and (*c*). It is likely that errors arising from known physical approximations in the theory account for the discrepancies. In the case of electron secondaries accompanying mesotrons, a study was made of the number of electrons with energy greater than E relative to the number of mesotrons. For small values of E, the theoretical values are too large by a factor of 2, but as E increases the discrepancy becomes smaller.

537.591.15 1909

The origin of large cosmic-ray bursts. LAPP, R. E. *Phys. Rev.*, **69**, 321–37 (*April* 1 *and* 15, 1946).—Integral size-frequency distribution curves for bursts of >100 particles were obtained, using an ionization chamber shielded by 1·25, 12 and 35 cm of Fe. These curves can all be represented by an inverse power law with exponent = 2·0 ± 0·2. The transition curve plotted from these data shows a pronounced maximum. For 1·25 cm of Fe, about 85%, for 12 cm, 20%, and for 35 cm, 5% of the bursts were observed to be coincident with extensive showers. The origin of the bursts not coincident with showers is discussed. For the analysis of the transition curve 3 different types of bursts are considered: due to extensive atmospheric showers, produced by narrow air showers or single high energy electrons, and produced by mesotrons (knock-on and bremsstrahlung processes). Data for bursts of >500 particles under 12 cm of Pb are compared with data under 35 cm of Fe to determine the dependence of burst frequency on atomic number; the results agree with production of these bursts by bremsstrahlung of the mesotron. Integral size-frequency distribution curves are also plotted for data obtained during a 5-year period at Huancayo (3 350 m) and at Cheltenham (72 m) for bursts under 12 cm of Pb. The Cheltenham data are compared with the theoretical calculations of Christy and Kusaka [Abstr. 1077 (1941)] for burst production by mesotrons of spin 0, ½ and 1; the data fit either the 0 or ½ curve, but exclude 1. The altitude dependence under 12 cm of Pb shows that the ratio of frequencies at Huancayo and Cheltenham is constant for bursts <2 400 particles, but increases sharply for still larger bursts. This increase is discussed on the basis that bursts under thick shields at higher altitudes may be caused either by extensive showers or by possible spin 1 mesotrons having so short a mean life that most of them fail to reach sea level.

537.591.5 1910

Mesotron intensity as a function of altitude. GILL, P. S. *Nature, Lond.*, **157**, 691 (*May* 25, 1946).—The results obtained by aeroplane flights up to 35 000 ft do not lie on an exponential curve, but show a hump at 550 mb pressure.

538.22 : 531.751.1 *see Abstr.* 1803

538.221 : 548.73 *see Abstr.* 1968

538.221 : 621.318.22 1911

Modern hard magnetic materials. HOSELITZ, K. *J. Sci. Instrum.*, **23**, 65–71 (*April*, 1946).—[Abstr. 1602 B (1946)].

538.222 1912

Further researches on paramagnetic absorption in iron ammonium alum. DIJKSTRA, L. J., GORTER, C. J., AND VOLGER, J. *Physica, 's Grav.*, **10**, 337–47 (*May*, 1943).—The absorption by ferric ammonium alum was studied at liquid air temperatures in con-

stant parallel and perpendicular fields. The results agree well with earlier determinations and with the value for the paramagnetic dispersion of the substance; the relaxation constants do not agree with those of Starr [Abstr. 2420 (1941)]. The behaviour of the magnetic relaxation constant in a parallel or perpendicular field is still not very clear, but certainly conflicts with the theory of Kronig and Bouwkamp [Abstr. 3396 (1938)].

538.3 = 4 1913

Magneto-electric induction. BOUTHILLON, L. *Bull. Soc. Franç. Élect.*, **1**, 553–76 (*Dec.*, 1941); *Disc.*, **2**, 120–40 (*March*); 262–74 (*July*, 1942); **3**, 45–56 (*Feb.*, 1943) *In French.*—The author considers the magnetic field of an electric current as being produced by the displacement of the electric field of the charges producing the current, and being carried with them, rather than directly due to the current. The law of Biot and Savart is then replaced by a law of local action depending solely on the electric induction and the speed at which the field is displaced. Considering this as the analogue of the electric force produced by electromagnetic induction, the author introduces the idea of a magneto-electric induction. He claims that if this idea be applied to a variable electric field, one can account for those phenomena which led Maxwell to introduce the displacement current. This procedure is considered to be a more satisfactory way of arriving at Maxwell's equations. V. C. A. F.

538.312 = 4 1914

On the magnetic energy of magnets. BRYLINSKY, E. *Bull. Soc. Franç. Élect.*, **2**, 298–314 (*Aug.*, 1942) *In French.*—The mutual magnetic energy of a permanent magnet and an electric current is derived from considerations of the hysteresis cycle, i.e. from the macroscopic properties of ferro-magnetic materials without necessarily attributing these to particular current elements. V. C. A. F.

538.56 : 621.396.611.4 = 3 1915

Electromagnetic similarity laws and their application to cavity resonators. KÖNIG, H. *Hochfrequenztech. u. Elektroakust.*, **58**, 174–80 (*Dec.*, 1941) *In German.*—[Abstr. 1659 B (1946)].

538.566 : 621.396.1 = 3 1916

Propagation of a surface wave over curved and stratified ground. GROSSKOPF, J. *Hochfrequenztech. u. Elektroakust.*, **58**, 163–71 (*Dec.*, 1941) *In German.*—[Abstr. 1653 B (1946)].

538.691 1917

The theory of the 180° magnetic focussing type of beta ray spectrometer. SAHA, A. K. *Indian J. Phys.*, **19**, 97–119 (*June*, 1945).—A rigorous mathematical theory has been worked out and an expression for the transmission factor as a function of the magnetic field and the electron momentum obtained. The transmission factor of the spectrometer of Lawson and Tyler [Abstr. 732 (1940)] has been completely calculated numerically in order to compare this theory with an earlier approximation.

RADIOACTIVITY . MOLECULES . ATOMS 539

539.11 1918

Theory of metals. GOMBÁS, P. *Nature, Lond.*, **157**, 668–9 (*May* 18, 1946).—The modified expression derived in Abstr. 1149 (1944) for the potential of a positive ion in a metal has been applied to the calculation of the interaction energy of the electron-gas with the ions. Theoretical values are quoted for the elementary sphere radius, the lattice energy, the sublimation energy, the work function and the compressibility of 4 alkali metals, which agree well with experiment.

539.13 : 535.338.4 1919

On the electronic structure of the nitrogen molecule. HERZBERG, G. *Phys. Rev.*, **69**, 362–5 (*April* 1 *and* 15, 1946).—It is shown that the Lyman–Birge–Hopfield bands of nitrogen represent a forbidden $^1\Pi_g - {}^1\Sigma_g{}^+$ transition. A considerable difficulty in the interpretation of the electronic states of N_2 by electron configurations is thus removed. A revised electronic energy level diagram of N_2 is given.

539.13/.15 1920

Classical models and many-electron atoms. COOK, M. A. *J. Chem. Phys.*, **14**, 62–6 (*Feb.*, 1946).—Based on classical models including the interpretation of the de Broglie wave as an electro-magnetic "atmosphere" which controls the orbit and the "action" of the classical electron, and postulating that the "atmosphere" of the electron suffers a permanent change only when the electron undergoes a change in its quantum state, an equation is derived for the He ground state *iso*-electronic sequence which agrees substantially with experiment. This view leads to the conclusion, moreover, that the binding energy in molecules formed without electronic transitions is caused entirely by a decrease in the average potential energy, the average kinetic energy of the molecule remaining the same as in the constituent atoms. This conclusion has been verified in the systems H_2 and $H_2{}^+$ [see Abstr. 224 (1946)]. Introducing the additional assumption that the resonance contribution to the total energy of a state, arising from an "adiabatic" orbital distortion, is proportional to the orbital frequency, equations are derived expressing the term values of a number of states of 2-, 3- and 4-electron atoms. The methods appear to apply quite generally.

539.133 : 541.57 1921

A note on bond lengths and ionization potentials in carbonyl compounds. WALSH, A. D. *Trans. Faraday Soc.*, **42**, 56–62 (*Jan.–Feb.*, 1946).—It is shown that the CO bond length in carbonyl compounds decreases as the ionization potential of the non-bonding $p\pi$ electrons on the oxygen atom rises. Rise of the ionization potential means decreased polar character. The relation forms a useful check on published values of carbonyl interatomic distances. The structures of a number of molecules are discussed and several predictions of bond distances made. It becomes possible to interpret the structure of carbon dioxide without recourse to the Pauling theory of resonance hybrids, viz., simply in terms of carbon-oxygen double bonds of low polarity. Some of the arguments given in favour of carbon monoxide containing a triple bond are not necessarily valid.

539.133 : 541.57 *see Abstr.* 1958

539.152.1 1922

On the heavy-electron pair theory in the limit of strong coupling. BLATT, J. M. *Phys. Rev.*, **69**,

285–97 (*April* 1 *and* 15, 1946).—The pair theory of Marshak and Weisskopf [Abstr. 665 (1941)] was investigated assuming strong coupling. The strong coupling criterion is $A = (Nf/\mu) > 5$ where f=coupling constant, μ = heavy electron mass, $N = \int U^2(x)d^3x$, $U(x)$ = source function of the nucleon. $N \simeq 1/\pi a^3$, where a = source radius (all in units where $h = c = 1$). With this condition, the magnetic moment turns out to be of order A^{-1}, and of magnitude too small to account for the observed anomalies. The leading term in the potential of the force between two nucleons (for $r_{AB} > 2a$) is independent of the spin orientations, of the coupling constants, and of the type of coupling (as long as no derivatives of the heavy-electron field quantities occur in the coupling term). This potential is identical with the one calculated by Jauch and Houriet [Abstr. 2894 (1942)]. The next term in the potential is of order A^{-3}. It corresponds to a superposition of a $(\Sigma_A \cdot \Sigma_B)$ term, a tensor force term, and an ordinary force. Being of order A^{-3} it is too small, however, to fit the experimental results.

539.152.1 1923

Distribution of energy levels for the liquid-drop nuclear model. Auluck, F. C., and Kothari, D. S. *Nature, Lond.*, **157**, 662 (*May* 18, 1946).

539.153 = 3 1924

Calculation of the energy of the (4s, 5s)-triplet-*S* state of the Ca atom. Péter, G. *Z. Phys.*, **119** (*Nos.* 11–12) 713–16 (1942) *In German.*—The eigenfunction and the energy are calculated with the aid of the method of Gombás [Abstr. 1149 (1944)]. The polarization of the core of the atom and the exchange interaction of the valence electrons with the core electrons are not taken into account. The calculated value of 13·38 eV is in good agreement with the empirical (14·00 eV). Empirical or semi-empirical constants are not used. H. G. S.

539.16.08 : 771.531.1–834 1925

A new photographic emulsion for the detection of fast charged particles. Powell, C. F., Occhialini, G. P. S., Livesey, D. L., and Chilton, L. V. *J. Sci. Instrum.*, **23**, 102–6 (*May*, 1946).—The new emulsion has about eight times the normal quantity of silver halide for a given amount of gelatine and has greatly improved properties over the ordinary "half-tone" emulsion. Characteristic photomicrographs are reproduced of the tracks of α-particles and protons, and it is shown that the "energy resolution" given by the method is much greater than that previously attained. Various chemical methods of improving the discrimination between the tracks of different types of particle are described. The improved visibility of the tracks and the absence of background allows a new approach to be made to the technical problems of (*a*) searching for rare events, (*b*) counting and measuring large numbers of tracks, and (*c*) loading emulsions with other atoms for specific experiments. The objections of some experimenters to the method would appear to have been overcome and this should lead to its widespread adoption for work in nuclear physics.

539.165.2 1926

Experimental test of beta-ray theory for the positron emitters Na^{22}, V^{48}, Mn^{52}, Co^{58}. Good, W. M., Peaslee, D., and Deutsch, M. *Phys. Rev.*, **69**, 313–20 (*April* 1 *and* 15, 1946).—The positron branching ratio $\lambda_+/(\lambda_c + \lambda_+)$ has been measured by a coincidence counting method for four isotopes in which radioactive decay involves competition between positron β-rays and orbital electron capture. The results are $_{11}Na^{22}$: 1·00 ± 0·05, $_{23}V^{48}$: 0·58 ± 0·04, $_{25}Mn^{52}$: 0·35 ± 0·02, $_{27}Co^{58}$: 0·145 ± 0·005. It is shown that these values, as well as the observed shapes of the β-ray spectra, and the observed lifetimes are in agreement with predictions of the β-ray theory for nuclear angular momentum changes $\Delta I = 0$ or $\Delta I = \pm 1$. The type of interaction remains uncertain, as does the parity change, except that the scalar interaction gives consistent results if one assumes the parity change in every case except Mn^{52}.

539.167.3 1927

Radioactivity induced by neutrons and deuterons in ruthenium. Bohr, E., and Hole, N. *Ark. Mat. Astr. Fys.*, **32 A** (*No.* 4) *Paper* 15, 8 *pp.* (1946).—Bombardment of Ru with neutrons gave rise to a 20 hr activity, which, however, was due to an impurity, probably Ir or Pt. Bombardment with deuterons and slow neutrons, followed by distillation of the Ru, revealed three activities, viz., 4·4 hr, 37 hr and 41 days. Irradiation with fast Li neutrons gave an activity of short period which was not further investigated. The reactions involved are

$$Ru^{104} + n \rightarrow h\nu + Ru^{105} \xrightarrow{4\cdot4h} e^- + h\nu$$
$$+ Ru^{105} \xrightarrow{37h} Pd^{105} + e^-$$
$$Ru^{102} + n \rightarrow h\nu + Ru^{103} \xrightarrow{41d} Ru^{103} + e^- + h\nu$$

The upper limits of the β-spectrum for Ru^{103}, Ru^{105} and Rh^{105} are 0·75 ± 0·07, 1·3 ± 0·1, and 0·78 ± 0·07 eMV, respectively, and the energy of the γ-rays for Ru^{103} and Ru^{105} are 0·4 ± 0·5 and 0·7 ± 0·07 eMV, respectively. A. J. M.

539.167.3 1928

Neutron-induced activities in caesium. Slätis, H. *Ark. Mat. Astr. Fys.*, **32 A** (*No.* 4) *Paper* 16, 12 *pp.* (1946).—When $_{55}Cs^{133}$ was irradiated with slow neutrons three active nuclei were produced with half-life periods 3·15 ± 0·2 hr, 5·92 ± 0·2 days and more than 254 days, respectively. The 5·92 day activity is probably due to the γ-emitting $_{54}Xe^{133}$. Absorption experiments in Al show that electrons with an upper energy limit of 1 ± 0·2 eMV are emitted in the case of the 254 day nucleus, and of 2·4 ± 0·5 eMV in the case of the 3·15 hr nucleus. In each case the energy of the emitted γ-radiation is about 0·7 eMV. The half-life of $_{17}Cl^{38}$ is 37·0 ± 1·5 min. A. J. M.

539.167.3 1929

Disintegration schemes of radioactive substances IX. Mn^{52} and V^{48}. Peacock, W. C., and Deutsch, M. *Phys. Rev.*, **69**, 306–13 (*April* 1 *and* 15, 1946).—Mn^{52} decays with the emission of positrons of maximum energy 0·582 ± 0·015 eMV, followed by three γ-rays in cascade, of energies 0·734 ± 0·015 eMV, 0·940 ± 0·02 eMV, and 1·46 ± 0·03 eMV, respectively. These energies are the multiples 3, 4 and 6 of 0·240 eMV, within experimental error. The orbital electron capture by Mn^{52} leads to the

same excited state of Cr^{52} as the positron emission with which it competes. The positrons of V^{48} are emitted with a maximum energy of $0{\cdot}716 \pm 0{\cdot}015$ eMV, with successive emission of two γ-rays of $1{\cdot}33 \pm 0{\cdot}03$ eMV and $0{\cdot}980 \pm 0{\cdot}02$ eMV energy. These energies are in the ratio 4 : 3. The disintegration schemes give the mass differences: $Mn^{52} - Cr^{52} = 5{\cdot}10 \pm 0{\cdot}15 \times 10^{-3}$ a.m.u. and $V^{48} - Ti^{48}, = 4{\cdot}37 \pm 0{\cdot}12 \times 10^{-3}$ a.m.u. Some evidence is also presented concerning the disintegration of V^{52} and of Sc^{48}. It is shown that β-ray theory explains consistently the lifetimes, the shapes of the positron spectra and the ratio of electron capture to positron emission if one assumes tensor interaction, angular momentum change $\Delta I = 0$ or $\Delta I = \pm 1$ (not $0 \nrightarrow 0$) without parity change in the case of Mn^{52} and with parity change in the case of V^{48}.

539.167.3 1930

Radioactive element 94 from deuterons on uranium. Search for spontaneous fission in 94^{239}. SEABORG, G. T., MCMILLAN, E. M., KENNEDY, J. W., AND WAHL, A. C. *Phys. Rev.*, **69**, 366–8 (*April* 1 *and* 15, 1946).—Notes withheld from publication since 1941.

539.167.3 : 539.185.7/.9 *see Abstr.* 1938

539.172 = 3 1931

Energies and masses of the uranium fragments on irradiation chiefly with thermal neutrons. JENTSCHKE, W., AND FRANKL, F. *Z. Phys.*, **119** (*Nos.* 11–12) 696–712 (1942) *In German.*—The simultaneous measurement of the energy of the two nuclear fragments obtained from a thin uranium foil bombarded chiefly with thermal neutrons is described. The kinetic energy of the two fragments together amounts on the average to 150 eMV. The heavier fragments had a mass between 127 and 162, the lighter fragments between 109 and 74. Fission into two equally heavy fragments does not occur. On the average, the greater the difference between the masses of the nuclear fragments, the lower the kinetic energy.

H. G. S.

539.172.3 1932

On the inelastic photodissociation of the deuteron. JAUCH, J. M. *Phys. Rev.*, **69**, 275–85 (*April* 1 *and* 15, 1946).—There exists the possibility of directly verifying the theoretical prediction of the existence of excited states of the nucleons at about 45 eMV above the ground state by an inelastic photo-electric dissociation process of the deuteron with γ-rays of energies larger than the excitation energy of these states. The cross section σ' for such processes is calculated in terms of the elastic cross section σ by using the simplest form of the strong coupling theory. The quantity σ'/σ has a maximum at about 87 eMV where it reaches the approximate value of 0·07. These processes should be experimentally detectable and would furnish valuable information about the properties of nuclei.

539.172.4 1933

Atomic energy from U^{238}. TURNER, L. A. *Phys. Rev.*, **69**, 366 (*April* 1 *and* 15, 1946).—This note (publication delayed from 1940) predicts that the long-lived β-descendants of U^{239}, formed by capture of neutrons by U^{238}, can be used for fission by thermal neutrons.

539.181 : 537.564 *see Abstr.* 1904

539.185 1934

Neutron scattering in ortho- and parahydrogen and the range of nuclear forces. WU, C. S., RAINWATER, L. J., HAVENS, W. W., JR., AND DUNNING, J. R. *Phys. Rev.*, **69**, 236–7 (*March* 1 *and* 15, 1946).—Commenting on the results of Alvarez and Pitzer [*Phys. Rev.*, **55**, 596 (1939); **58**, 1003 (1940)] on the scattering cross section of neutrons for para- and orthohydrogen ($5{\cdot}2 \times 10^{-24}$ cm² and 100×10^{-24} cm²), it is pointed out that these are not in agreement with calculations assuming the range of nuclear forces to be $2{\cdot}8 \times 10^{-13}$ cm and the scattering cross section by free protons to be 21×10^{-24} cm². It is suggested that at such low temperatures the walls of the container may have acted as a catalyst converting the ortho- to parahydrogen. W. E. D.

539.185 1935

A reproducible neutron standard. GAMERTSFELDER, G. R., AND GOLDHABER, M. *Phys. Rev.*, **69**, 368–9 (*April* 1 *and* 15, 1946.)—Consists of a cylindrical Be block with a hole for the insertion of a Ra source. The neutrons are produced by the nuclear photo effect at the rate of 62 ± 7 neutrons/mcurie Ra/sec.

539.185 1936

Resonance scattering of fast neutrons. GRAHAME, D. C. *Phys. Rev.*, **69**, 369–70 (*April* 1 *and* 15, 1946).—Certain phenomena of the scattering of fast neutrons are inadequately explained by current theories, and a new hypothesis is proposed, which would allow inelastic scattering with small energy loss. The incident neutron interacts at first with only a small portion of the nucleus and may be re-emitted soon after with nearly all its original energy, which has not yet been shared with any large number of particles.

539.185.08 1937

Determination of absolute neutron intensities. O'NEAL, R. D., AND SCHARFF-GOLDHABER, G. *Phys. Rev.*, **69**, 368 (*April* 1 *and* 15, 1946).—The procedure consists of 2 steps: (*a*) Determination of the ratio R of the number of neutrons activating a $MnSO_4$ solution with and without the presence of an absorber (consisting of finely powdered manganese). (*b*) Determination of the number of neutrons (N_a) captured by the absorber per unit time.

539.185.7/.9 : 539.167.3 1938

On the activities caused by n–γ processes and the absorption coefficient for thermal neutrons. GROENDIJK, H., AND DE VRIES, H. *Physica, 's Grav.*, **10**, 380–90 (*June*, 1943).—Absolute values are given for the activities due to both thermal and resonance neutrons in a well defined arrangement. The results may easily be converted for other arrangements. From the activations by thermal neutrons the absorption coefficients for these neutrons are calculated for the following nuclei: Au^{197}, Ag^{107}, Ag^{109}, Cu^{63}, Cu^{65}, Al^{27}, Zn^{68}, Br^{79} and I^{127}.

ELASTICITY . STRENGTH.. RHEOLOGY 539.3/.8

539.31 1939

The elasticity of a network of long-chain molecules. III. TRELOAR, L. R. G. *Trans. Faraday Soc.*, **42**, 83–94 (*Jan.–Feb.*, 1946).—The accurate functions representing the distribution of length of long-chain molecules are introduced into the Flory–Rehner

model, by means of which the mechanical properties of a network of such molecules, corresponding to a vulcanized rubber, may be calculated. Stress-strain curves are obtained for (*a*) simple elongation and (*b*) 2-dimensional extension, using chain lengths corresponding to polyisoprene rubbers of molecular weight (M) between junction points of the network of 1 200 and 4 800 respectively. These curves show all the essential features of the corresponding experimental curves for natural rubber, right up to the breaking point, though the extensibility of the real rubber is significantly less than the theoretical. They show also that the stress for a given small or moderate deformation is inversely proportional to M, whilst the range of extensibility is directly proportional to $M^{\frac{1}{2}}$.

539.31 : 537.228.1 : 548.0 = 3 *see Abstr.* 1962

539.31 : 541.68 1940

Elastic loss and relaxation times in cross-linked polymers. KIRKWOOD, J. G. *J. Chem. Phys.*, **14**, 51–6 (*Feb.*, 1946).—The outlines of a theory of elastic loss in cross-linked polymers are developed on the basis of the ideas underlying the theory of dielectric loss of Fuoss and Kirkwood [Abstr. 1267 (1941)] and the 3-dimensional network model of rubber structure proposed by James and Guth [Abstr. 257 (1944)]. The relaxation time distribution function for elastic loss is given in the approximation of free internal rotation of chain segments of the net. The influence of intermolecular hindering torques and network restraints on the relaxation time spectrum is discussed, but explicit calculations are postponed for a later report.

539.374 1941

A new approach to the theory of relaxing polymeric media. GREEN, M. S., AND TOBOLSKY, A. V. *J. Chem. Phys.*, **14**, 80–92 (*Feb.*, 1946).—A molecular theory is presented which gives an expression for the stress in terms of the strain history. At any given time the strain history produces a distribution in internal strains which for mechanical properties can be characterized by a limited number of internal strain parameters. The second law of thermodynamics is used to define dissipation of energy at constant temperature and explicit expressions for dissipation of energy for any strain history are obtained. Inasmuch as relaxation during straining causes an essential reorganization of structure which is in fact the cause of dissipation, the kinetic theory of elasticity is extended to non-isotropic polymeric networks. A tensor expression for the stress-strain-time relations is thereby developed.

539.374 : 541.68 1942

Stress-time-temperature relations in polysulfide rubbers. STERN, M. D., AND TOBOLSKY, A. V. *J. Chem. Phys.*, **14**, 93–100 (*Feb.*, 1946).—Polysulphide rubbers of various internal structures have been investigated by measurements of continuous and intermittent relaxation of stress and by creep under constant load at temperatures between 35°c and 120°c. Continuous stress relaxation measurements indicate that these rubbers approximately obey the simple Maxwellian law of relaxation of stress, which indicates that one definite type of bond in the network structure is responsible for stress decay. The activation energy for the relaxation process in each of the polysulphide rubbers is nearly the same, indicating that the same type of bond is responsible for the relaxation behaviour of all the polysulphides investigated. In contrast to the hydrocarbon rubbers, oxygen is not the cause of high temperature relaxation in polysulphide rubbers, nor does heating in air at moderate temperatures for times comparable to the relaxation time produce changes in physical properties as determined by modulus or by appearance of the samples. Several possibilities regarding the mechanism of the relaxation process and the type of bond involved are considered in the light of the experimental results.

539.4.019.1 1943

Effect of duration of loading on the strength of glass. GURNEY, C. *Nature, Lond.*, **157**, 662 (*May* 18, 1946).—[See Abstr. 579 (1946)].

539.434 : 620.172.22 : 669.14 1944

A comparison of some carbon steels on the basis of various creep limits. JOHNSON, A. E., AND TAPSELL, H. J. *Proc. Instn Mech. Engrs, Lond.*, **153** (*War Emerg. Issue No.* 6) 169–79 (1945).—[Abstr. 1723 B (1946)].

PHYSICAL CHEMISTRY 541

REACTION KINETICS 541.121/.128

541.124 : 542.943 1945

The oxidation of liquid hydrocarbons. I. The chain formation of hydroperoxides and their decomposition. GEORGE, P., RIDEAL, E. K., AND ROBERTSON, A. *Proc. Roy. Soc. A*, **185**, 288–309 (*March* 14, 1946).

541.124 : 542.943 1946

The oxidation of liquid hydrocarbons. II. The energy-chain mechanism for the thermal oxidation of tetralin. GEORGE, P., AND ROBERTSON, A. *Proc. Roy. Soc. A*, **185**, 309–36 (*March* 14, 1946).

541.124 : 542.943 1947

The oxidation of liquid hydrocarbons. III. The oxidation of tetralin in the presence of benzoyl peroxide as a free radical chain reaction GEORGE, P. *Proc. Roy. Soc. A*, **185**, 337–51 (*March* 14, 1946).

541.124.7 : 537.568 *see Abstr.* 1905

541.126 1948

The mechanism of the hydrogen-oxygen reaction. I. The third explosion limit. II. The reaction occurring between the second and third explosion limits. III. The influence of salts. WILLBOURN, A. H., AND HINSHELWOOD, C. N. *Proc. Roy. Soc. A*, **185**, 353–80 (*April* 5, 1946).—The influence on the third limit of (*a*) hydrogen-oxygen proportions, (*b*) additions of N_2, CO_2 and steam were examined, the measurements being made mainly at 586°c in a silica vessel coated with KCl, which controls the reaction chains. The results agree qualitatively with the theory that the third limit depends upon the branching of reaction chains. An expression is derived for the rate of formation of water in the steady state and this leads

o a satisfactory description of the third limit. In II xperiments are described on the rate of reaction etween H_2 and O_2 at pressures lying between the econd and third explosion limits. The equation for he rate of combination of H_2 and O_2 is factorized by onsidering first the condition for the third explosion imit. This allows the determination of most of the onstants. With the help of these results the rate xpression is tested and the form of the function lescribing the initial reaction is examined. It is con-luded that the chains are probably initiated by the issociation of $H_2 : H_2 + M = 2H$. In III the nfluence of KCl, KI, CsCl, Cs, I, etc., on the ex-losion limits and on the rate of the reaction occurring etween the second and third limits is examined. odides differ greatly from the other halides. The ffect of the salts is probably due to specific chemical nteractions. L. S. G.

541.126.2 1949

Initial stages of the explosion of nitroglycerine. VINES, R. G., AND MULCAHY, M. F. R. *Nature, Lond.*, **157**, 626 (*May* 11, 1946).—The detonation of a thin layer of nitroglycerine confined between a glass and a brass sheet was photographed on a rotating drum camera. Two distinct stages in the spread of the explosion could be detected, corresponding to velocities of propagation of 400 and 2 000 m/sec respectively. With a thick layer an initial very fast (5 000 m/sec) process was also apparent.

ELECTROCHEMISTRY 541.13

541.133 : 537.312.5 1950

Electronic processes in liquid dielectric media. Properties of metal-ammonia solutions. OGG, R. A., JR. *J. Amer. Chem. Soc.*, **68**, 155 (*Jan.*, 1946).—Extremely dilute liquid NH_3 solutions of metallic Na show a marked increase in electrical conductivity upon irradiation with visible light. This effect was observed in the temperature range -35 to -75°C. The quantum efficiency of this photo-conductivity is an inverse function of the concentration of the solution and thus with reasonable light intensities, the effect is experimentally observable only at low concentrations of the order of 10^{-5}M. Dilatometric measurements at -35°C, in which metallic Na was extracted from solutions of about 3×10^{-3}M indicated a volume change of approximately 700 cm³/mole of solute. The quantum mechanical considerations lead to the conclusions, (*a*) that the ground state of the system is an "S" state of total energy -4 800 cal/mole in a cavity of radius $7{\cdot}6 \times 10^{-8}$ cm; (*b*) all other states are unstable; (*c*) photo-conductivity follows a transition from the ground state to the lowest "P" state; and (*d*) two electrons trapped in the same cavity are appreciably stable with respect to either two electrons in separate cavities or one trapped and one conducting electron. The absorption spectrum and magnetic susceptibility of metal ammonia solutions are in at least qualitative agreement with these calculations. [See Abstr. 1894 (1946)]. W. R. A.

541.134 1951

Reproducibility of the lead electrode and the electromotive force of the lead stick-lead amalgam cell at 0° to 60°C. BATES, R. G., EDELSTEIN, M., AND ACREE, S. F. *J. Res. Nat. Bur. Stand., Wash.*, **36**, 159–70 (*Feb.*, 1946).—The potentials of 4 types of solid Pb electrodes with respect to saturated Pb amalgam were obtained. Although Pb anneals spontaneously, the surface condition has a profound effect upon the electromotive force. Untreated Pb sticks were, in general, positive to Pb the surface of which had been rendered strain-free. When etched in a mixture of nitric acid and Pb nitrate, these sticks soon reached the same potential. Removal of air from the solutions improved the agreement among the electrodes. The difference of potential between stick lead and 8% Pb amalgam at intervals of 5° from 0° to 60°C is given by the equation $E = 0{\cdot}005347 + 0{\cdot}0000201t$, where E is the electromotive force in international volts and t is in degrees centigrade. Thermodynamic constants were computed from the temperature coefficient of electromotive force.

PHOTOCHEMISTRY 541.14

541.141.1 1952

The quantum yield in the photo-reaction between methyl iodide and nitric oxide. IREDALE, T., AND MCCARTNEY, E. R. *J. Amer. Chem. Soc.*, **68**, 144–5 (*Jan.*, 1946).—When the nitric oxide pressure is above 50 mm the quantum yield reaches a value between 0·9 and 1·2. This degree of accuracy of the experimental results permits the adoption of the interpretation of the reaction as $CH_3I \rightarrow CH_3 + I$, $CH_3 + NO \rightarrow CH_3NO$, $I + I \rightarrow I_2$. The back reactions, $CH_3 + I_2 \rightarrow CH_3I + I$, and $CH_3 + I \rightarrow CH_3I$, begin to lower the quantum yield only when the nitric oxide pressure is low. The iodine formed was frozen out and titrated with approximately 0·005N thiosulphate. The CH_3NO or its decomposition product was not identifiable. W. R. A.

541.141.7 : 535.343.4 *see Abstr.* 1860

541.148 : 541.183.55 *see Abstr.* 1955

COLLOIDS . ADSORPTION 541.18

541.18 : 532.582.7 *see Abstr.* 1815

541.182.2.053 : 532.529 *see Abstr.* 1814

541.182.6 1953

Theory of the stability of lyophobic colloids. VERWEY, E. J. W. *Philips Res. Rep.*, **1**, 33–49 (*Oct.*, 1945).—The forces acting between colloidal particles are assumed to be due to a superposition of an attractive potential caused by van der Waals–London forces, and a double layer interaction potential caused by the interpenetration of the diffuse charges of the electrical double layers surrounding the particles in the liquid. It is assumed that the double layer potential ψ_0 is independent of the electrolyte concentration and that it remains constant when two particles meet. A general expression for the free energy of a double layer or a double layer system is derived, and from this an expression for the interaction potential V_R can be obtained. The result of the double layer interaction is always a repulsion. In combination with the van der Waals–London attractive potential V_A this leads to total potential curves of two types: (*a*) curves showing a maximum corresponding to positive values of $V_R + V_A$, and

(*b*) curves for which $V_R + V_A$ is everywhere negative. The former type would correspond roughly to stable sols or suspensions. The theory gives a quantitative explanation of the Schulze–Hardy rule, and shows that under certain conditions the flocculation values of monovalent, divalent and trivalent ions will be as $1 : (\frac{1}{2})^6 : (\frac{1}{4})^6$. The value found for the van der Waals–London constant agrees well with the value predicted by quantum theory.

541.183 1954

The equilibrium spreading pressure of oleic acid and of ethyl sebacate on concentrated salt solutions. DONNISON, J. A., AND HEYMANN, E. *Trans. Faraday Soc.*, **42**, 1–5 (*Jan.–Feb.*, 1946).—In all cases, except that of potassium fluoride, salts increase the equilibrium spreading pressure with increasing activity, giving an approximately linear relation in the order of decreasing energy of hydration, viz.:

Li < Na < K < Rb, and F < Cl < Br < I < CNS.

However, in the case of ethyl sebacate, the behaviour of the cations is irregular. The results are discussed visualizing two effects: (*a*) an increase of the attraction between the organic molecules and the substrate; (*b*) an increase of the repulsive terms in the system of forces between the molecules of the film. Both effects are due to the presence of ions in the "film phase" and will increase with decreasing energy of hydration of the ions.

541.183.55 : 541.148 1955

Photo-adsorption effects in the system pigment-fluid phase. HEDVALL, J. A., AND NORD, S. *Ark. Kemi Min. Geol.*, **17 A** (*No.* 3) *Paper* 11, 11 *pp.* (1943).—Measurements are reported of the adsorption of phthaleins by suspensions of red and black HgS and by CdS under irradiation and in darkness. Results indicate that the diminution of concentration in the suspensions exposed to light is due to a photo-adsorption effect. The black HgS shows similar adsorption capacity in light or darkness, but the red HgS adsorbs up to 6 times as much phenolphthalein in light as in darkness. This difference must be connected with the electronic structure of the two forms. The change in surface activity through addition or removal of an excess of one of the components is evident in the HgS and in CdS. The possibility of an analogy between the Becquerel or photo-voltaic effect and the photo-adsorption effect is discussed.

N. M. B.

541.185 : 778.31 1956

Light-field ultramicrophotography of lyogels. HAUSER, E. A., AND LE BEAU, D. S. *J. Amer. Chem. Soc.*, **68**, 153–4 (*Jan.*, 1946). *See also Industr. and Engng Chem.*, **38**, 335–8 (*March*, 1946).—A number of colour photographs have been made of lyogels using Kodachrome A film. The absence of any grain in the developed film permits of considerable enlargement. Enlargements have been made on regular printing paper using the Kodachrome picture as negative, and the resulting positive is termed the "light-field ultramicrograph" since it is really a reversed ultramicroscopic effect. This technique enables a satisfactory print to be obtained from the colour slide wherever a specific colour is not the predominant factor in the study of the preparation. A similar result can be obtained without using Kodachrome if the dark-field negative is exposed to a film and the resulting positive used for making the prints.

W. R. A.

CHEMICAL STRUCTURE 541.2/.6

541.5 1957

The electronic theory of valency. ANANTHAKRISHNAN, S. V. *Curr. Sci.*, **15**, 33–5 (*Feb.*, 1946).—Proceedings of a symposium at the Annual Meeting of the Indian Academy of Sciences, at Udaipur, Dec., 1945.

541.57 : 536.413 : 536.763/.764 : 584.73 *see Abstr.* 1967

541.57 : 539.133 1958

Molecular constants and chemical theories. V. Some remarks on physical constants and theories of higher valence states. SAMUEL, R. *J. Chem. Phys.*, **13**, 572–84 (*Dec.*, 1945).—Replies to criticism [see Abstr. 2512 (1945)] of the author's earlier papers [see Abstr. 2514 (1945)].

541.57 : 539.133 *see Abstr.* 1921

541.612 1959

The statistical length of long-chain molecules. TRELOAR, L. R. G. *Trans. Faraday Soc.*, **42**, 77–82 (*Jan.–Feb.*, 1946).—A formula is derived for the complete function representing the probability of a given distance between the ends of a chain of universally jointed equal links. The formula is computed for chains of 25 and 100 links. The distribution functions derived from this formula are compared with those previously worked out by an independent method for polyisoprene and paraffin chains. It is shown that the polyisoprene chain is statistically equivalent to a randomly-jointed chain of length corresponding to 1·42 links per isoprene unit.

541.68 : 539.31 *see Abstr.* 1940

541.68 : 539.374 *see Abstr.* 1942

CHEMICAL PROCESSES 542

542.943 : 541.124 *see Abstr.* 1945–1947

CHEMICAL ANALYSIS 543/545

545.8 1960

Quantitative analysis by the variation of the specific activity of an added radioactive isotope. SUE, P. *Nature, Lond.*, **157**, 622 (*May* 11, 1946).

545.81 : 531.717 *see Abstr.* 1802

545.82 : 535.34–15 1961

Recording infra-red analysers for butadiene and styrene plant streams. WRIGHT, N., AND HERSCHER, L. W. *J. Opt. Soc. Amer.*, **36**, 195–202 (*April*, 1946).—Optically the instrument consists of a double beam system employing a single source of radiation, a split lens or mirror, a sample cell and various filters through which one or both beams may pass, and two electrically opposed detectors upon which the beams are focused. Selectivity of wavelength is provided by the filters and by detectors having selectively absorbing radiation receivers. The detectors are two opposed arms of an a.c. excited bolometer made of fine nickel wire em-

bedded in a selectively absorbing medium. Operation on plant streams of butadiene-butene gas mixtures and of styrene-ethyl-benzene liquid mixtures is detailed.

CRYSTALLOGRAPHY 548

548.0 : 539.31 : 537.228.1 = 3 1962

On the piezoelectric ΔE-effect of Rochelle salt [Seignette] dielectrics. MATTHIAS, B. *Helv. Phys. Acta*, **16** (*No.* 2) 99–135 (1943) *In German.*—A theory is given of the anomalous elastic behaviour of Seignette dielectrics. The apparatus and method of measuring the pure ΔE-effect and the damping are described and the results of some experiments are discussed in relation to the theory. L. S. G.

548.12 = 4 1963

On "double" crystallographic groups. OPECHOWSKI, W. *Physica, 's Grav.*, **7**, 552–62 (*June*, 1940) *In French.*—The concept of "double group," introduced by Bethe [Abstr. 892 (1930)], is defined precisely by representing the group of rotations in terms of a group of transformations of two complex variables. The general theory is applied to tetrahedral and rhombohedral groups, and particularly to the perturbation of a state of quantum number J by fields with these symmetries. A. J. C. W.

548.524 : 669.6 = 393 1964

Formation of tin crystals. BRANDSMA, W. F., AND STAP, M. *Physica, 's Grav.*, **10**, 790–4 (*Dec.*, 1943) *In Dutch.*—Liquid Sn was allowed to solidify partially in a cast-iron mould, the remaining liquid being run off. The crystal formation was studied at various rates of cooling. Growth takes place by dendrite-formation in the basal plane, the directions of fastest growth being the base diagonals. The crystals are thus plates perpendicular to the tetragonal axis, but somewhat imperfect. A. J. C. W.

548.572 1965

Cleavage of calcite. TOLANSKY, S., AND KHAMVAVI, A. *Nature, Lond.*, **157**, 661–2 (*May* 18, 1946).—Optical interference methods were used for the examination of the cleavage faces. Evidence is found for some form of coarse mosaic block structure.

548.73 1966

On the crystal structure of phthalimide. I. Determination of the space-group. BAGCHI, S. N., AND KASEM, M. A. *Indian J. Phys.*, **19**, 93–6 (*June*, 1945).—The axial ratios, obtained from X-ray studies, are $a : b : c = 2{\cdot}98 : 1 : 0{\cdot}4946$. The space group is C_{2h}^5—$P2_1/n$.

548.73 : 536.413 : 536.763/.764 : 541.57 1967

Structure and thermal properties of crystals. VI. The role of hydrogen bonds in Rochelle salt. UBBELOHDE, A. R., AND WOODWARD, I. *Proc. Roy. Soc. A*, **185**, 448–65 (*April* 5, 1946).—X-ray measurements of changes in the lattice spacings of Rochelle salt between −90°C and 40°C were made, and the thermal properties were correlated with crystal structure. Thermal expansion is largest in the direction of the hydrogen bonds, but this predominance largely disappears above the upper Curie point. Between the two Curie points, −20° and 24·5°C, the thermal expansion is anomalous and there is a hysteresis effect. The thermodynamic changes at the upper and lower Curie points are discussed on the basis of the experimental data. X-ray evidence shows that over the transition range of temperatures measurable differences can be detected between subcrystalline domains within a "single" crystal. These differences reach a maximum in certain directions in the crystal but are insufficient to cause it to break up into a powder, with change of phase, at the two Curie points, so that most of the properties of a single crystal are retained over the whole range of temperatures. The onset of anomalous dielectric properties at the lower Curie point is ascribed to the stretching of short hydrogen bonds owing to the thermal expansion of the crystal. This changes the bonds from a polar to a non-polar character. L. S. G.

548.73 : 538.221 1968

The structure of cubanite, $CuFe_2S_3$, and the co-ordination of ferromagnetic iron. BUERGER, M. J. *J. Amer. Chem. Soc.*, **67**, 2056 (*Nov.*, 1945).—Cubanite, which is ferromagnetic and orthorhombic, has space group *Pcmn*; the cell, containing four molecules, has $a = 6{\cdot}45$, $b = 11{\cdot}095$ and $c = 6{\cdot}221$ *kX*. By using intensity data from Weissenberg photographs the structure consists of Cu atoms and one-third of the S atoms at the equipoint 4*c*, whilst the Fe atoms and the rest of the S atoms are in the general position 8*d*. Approximate parameters have been determined. The metals are each surrounded by four S atoms in almost undistorted tetrahedral co-ordination, and S atoms are surrounded by four metals in tetrahedral co-ordination. The structure may be regarded as made up of vertical slices of the wurtzite arrangement joined to identical but inverted slices by means of the sharing of one of the edges of each Fe co-ordination tetrahedron. Thus the Fe atoms are brought together in pairs across the shared edges, and suggests that the Fe atoms are linked to one another in pairs as well as being linked to four S atoms; and this unusual linking appears to be the cause of the ferromagnetism of the crystal. W. R. A.

548.73 : 669.65 1969

X-ray studies of binary alloys of tin with transition metals. NIAL, O. *Univ. Stockholm Inaug. Diss.*, 103 *pp.* (1945).—The systems studied are Fe–Sn, Co–Sn, Ni–Sn, Cr–Sn, Mn–Sn, Ru–Sn, Rh–Sn, Pd–Sn, Ir–Sn and Pt–Sn; and in the case of rhenium and osmium it is found that these are not perceptibly soluble in tin. The lattice dimensions are determined for the various phases in each system and the temperature ranges in which these phases exist are found. New equilibrium diagrams are set up on the basis of the results obtained. Structural analogies are discussed. Fe_3Sn, Ni_3Sn and Mn_3Sn belong to the Ni_3Sn type, DO_{19}. FeSn and CoSn belong to the CoSn type B35. $IrSn_2$ and $PtSn_2$ are isomorphous with CaF_2. $FeSn_2$, $CoSn_2$, $MnSn_2$ and $RhSn_2$ are analogous with $CuAl_2$. The data of the phases of the

latter are given in tabular form. There is a comprehensive bibliography. L. S. G.

548.734.2 1970

Investigation of lattice defects by means of X-rays. I. Tin. ARLMAN, J. J., AND KRONIG, R. *Physica, 's Grav.*, **10,** 795–800 (*Dec.*, 1943).—Transmission Laue photographs (Cu target) of a Sn crystal, prepared as described in Abstr. 1964 (1946), show two diffuse squares surrounding the central spot. These are attributed to first and second order diffraction of wavelengths lying between 0·424 Å (*K* absorption edge of Sn) and 0·484 Å (sudden drop in sensitivity of film at *K* absorption edge of Ag) by a defect structure in which lines of Sn atoms are displaced parallel to the *a* axes. Laue photographs with a Mo target show an additional square due to the Mo characteristic radiation. A. J. C. W.

548.735 : 535.421 1971

The construction and use of a "fly's eye" for assisting X-ray structure analysis. STOKES, A. R. *Proc. Phys. Soc., Lond.*, **58,** 306–13 (*May*, 1946).—The "fly's eye" is the name given to a multiple camera for producing two-dimensional diffraction gratings consisting of repeated patterns representing projections of crystal structures. This paper describes the construction of a fly's eye using lenses embossed on Perspex; also the necessary adjustments, the method of photographing a structure, and the apparatus for viewing the spectra produced by the two-dimensional gratings so obtained.

GEOPHYSICS 55

550.312 1972

Gravity over the Hawaiian Archipelago and over the Madeira area: conclusions about the earth's crust. VENING MEINESZ, F. A. *Proc. Ned. Akad. Wet.*, **44** (*No.* 1) 2–12 (1941).—Both regions are volcanic islands rising from the floor of the ocean. Altogether 32 gravity observations are analysed: in the Hawaii group 15 land and 6 submarine; in Madeira, 3 land and 8 submarine. Station elevations range from 3 981 m above to 5 430 m below sea level in the former and from 1 530 m above to 4 430 m below in the latter region. In both, the free air anomalies over the ocean are small; on land, values up to +698 milligals are found. As there is no geological evidence of subsidence, isostatic equilibrium is assumed. Isostatic reductions are calculated on Heiskamen's assumption for crustal thicknesses of $T = 30$ and 80 km, and also on Vening Meinesz' (regional) assumption for $T = 30$, $R = 58{\cdot}1$, $116{\cdot}2$, $174{\cdot}3$ and $232{\cdot}4$ km. The effect of increasing the density (d) assumed for the crust from 2·67 to 2·937 and 3·07 is also computed. Results are tabulated. The smallest anomalies are found for $T = 30$, $R = 232{\cdot}4$, $d = 2{\cdot}937$ and $T = 30$, $R = 174{\cdot}3$, $d = 3{\cdot}07$ though results for $T = 30$, $R = 0$, $d = 2{\cdot}67$ are only slightly greater. This indicates that in both regions the crust of the earth is rigid down to a depth of 25–45 km. B. C. B.

550.312 1973

Gravity over the continental edges. VENING MEINESZ, F. A. *Proc. Ned. Akad. Wet.*, **44** (*No.* 8) 883–7 (1941).—Regional isostatic reductions have been made for 26 gravity profiles at right angles to the edge of the continental shelf. In two cases, detailed results are given in the form of curves. For the remainder, only mean values are tabulated for $R = 0$, $29{\cdot}05$, $58{\cdot}1$, $116{\cdot}2$, $174{\cdot}3$ and $232{\cdot}4$ km and $T = 20$ and 30 km. The smallest anomalies are found for $R = 50$, $T = 20$ and $R = 100$, $T = 30$. Seismic evidence is then considered: it is suggested that most of the present gravity and seismic data can be explained by assuming that the granitic layer is thick only under the continents and ends rather abruptly near the edge of the continental shelf. B. C. B.

550.341 1974

Features of the travel-time curves of seismic rays. BULLEN, K. E. *Mon. Not. R. Astr. Soc., Geophys. Suppl.*, **5** (*No.* 4) 91–8 (1945).—The characteristics of seismological travel-time tables are theoretically derived from specific forms of the variation of the *P*- and *S*-velocities in the earth's interior. Use is made of the functions $d\Delta/dp$ and $\zeta(r) = d \log v/d \log r$. ($\Delta$ = angle subtended at the earth's centre by a ray of parameter p; v = velocity at distance r from centre.) The approximation $v = ar^b$ (a, b, constants) of the standard formula gives accurate results, especially for the region between the crustal layers and the level reached by rays for which $\Delta = 20°$ (agreement with Jeffreys' 1940 tables for *P* within about 0·2 sec). A. B.

550.341 1975

Effect of ray curvature upon seismic interpretations. STULKEN, E. J. *Geophysics*, **10,** 472–86 (*Oct.*, 1945).—Neglect of curvature introduces errors dependent upon the increase of velocity with depth; velocities from straight path computations are 2% or more too high. These inaccuracies are illustrated graphically for a specific family of velocity functions. The discrepancies caused by using straight line methods for the determination of depth, dip and offset are discussed. Dip discrepancies are less than 8 ft/1 000. A. B.

550.341 : 534.011/.012 *see Abstr.* 1825

550.341.2 1976

Seismic investigations in the Boulder Dam area, 1940–1944, and the influence of reservoir loading on local earthquake activity. CARDER, D. S. *Bull. Seism. Soc. Amer.*, **35,** 175–92 (*Oct.*, 1945).—Upward thrusting of masses of granitic rocks with slumping and partial upending of intermediary sedimentary and volcanic rocks has formed some of the ranges and intermontaine valleys of the Colorado River region west from Grand Canyon. The Calville basin of Lake Mead, north of Boulder Dam, has settled on such faults, which have been quiescent during Pleistocene and recent times. The weight of the newly created Lake Mead has depressed the underlying crustal blocks by probably several inches. The granitic masses on the opposite sides of the faults have remained relatively stationary. The semi-mountainous country north of the lake has moved downwards. Several hundred small earthquakes have been located since November 1940 in the fault south of Calville basin (estimated number in 10

years: 6 000). Graphs correlating them with increase and seasonal fluctuations of the water load in the period 1935–1944 (from 0 to 36×10^9 tons, corresponding to lake elevations 700–1 200 ft), indicate preponderance of felt shocks for the first peak load in 1936 and for subsequent seasonal increases. A. B.

550.373 1977

Diurnal-variation anomalies at Tucson. ROONEY, W. J. *Terr. Magn. Atmos. Elect.*, **50**, 175–84 (*Sept.*, 1945).—The seasonal changes in diurnal variation at Tucson for earth-current potential gradient, as indicated by monthly hodograms, are consistent with the recognized movement of the current systems in the ionosphere northwards and southwards with the sun. Two anomalies are, however, found to exist. Firstly, a marked increased activity during January; secondly, a decrease in the eastward component during March. Corresponding anomalies are found in the daily variation of the magnetic elements. The winter anomaly may be associated with a zone of unusually high conductivity in the ionosphere into which the current system moves at its southernmost position. The March anomaly seems more difficult to explain, but may be due to erratic shifting of the latitude of the current-centre. V. C. A. F.

550.384 : 551.513 *see Abstr.* 1993

550.384.3 : 550.389 1978

Geomagnetic secular variations and surveys. FLEMING, J. A. *Proc. Phys. Soc., Lond.*, **58**, 213–47 (*May*, 1946).—During the war, much attention has been devoted to the study and analysis of data well distributed over the earth's entire surface at more than 10 000 stations. These have resulted, for the first time, in the preparation of accurate isoporic charts, that is, charts of equal annual rate of change, for magnetic declination, inclination and the horizontal, vertical, eastward, northward and total components of the field for the four epochs of 1912·5, 1922·5, 1932·5 and 1942·5. The motions of the maximum and minimum isoporic foci during these four epochs indicate the complexity of the secular changes and interpretations. Isomagnetic charts based upon surface observations must always be limited, so far as faithful depiction of the field is concerned. Progress in instrumentation during the war makes feasible the early realization of magnetic surveys by airplanes at several different levels. Some of the potentialities, possibilities and needs for intense national and international co-ordination in magnetic surveys by plane are reviewed.

550.384.4 1979

Persistent solar rotation period of 26·875 days and solar-diurnal variation in terrestrial magnetism. OLSEN, J. *Nature, Lond.*, **157**, 621 (*May* 11, 1946).—Measurements made at Godhavn, Greenland, over a period of 15 years have established that the amplitude of daily variation of terrestrial magnetism varies (through a range of 1 : 4) with a period of 26·875 days. The variation persisted through the quiet summers 1932–36. It practically vanishes in winter and was not observed at Lovoe, Sweden, nor Huancayo, Peru, indicating that not only a sunlit atmosphere but charged particles from the sun are a necessary factor. The indication is that the corpuscles giving rise to the c_1-variation are controlled from an inner layer in the sun with a fixed speed of rotation.

550.389 1980

On the mutual consistency of magnetic charts. DAVIDS, N., AND BERNSTEIN, A. *Terr. Magn. Atmos. Elect.*, **50**, 199–214 (*Sept.*, 1945).—It is found that the curl-test for mutual consistency of magnetic charts, as proposed and used by Chapman [Abstr. 1980 (1942)], is useful only to a limited extent in determining such mutual consistency. The test requires that either the gradients be measured more accurately than is possible at present, or that inconsistencies be large enough, as compared with errors in their observation, to be detected. V. C. A. F.

550.389 : 550.384.3 *see Abstr.* 1978

550.834 1981

Repeated *P*-waves in seismic exploration of water covered areas. LAY, R. L. *Geophysics*, **10**, 467–71 (*Oct.*, 1945).—Discussion of the observations of special *P*-waves following the normal *P*-waves by a time interval depending on the size of the explosive charge, varying with its cube root, and therefore proportional to the radius of a spherical gas bubble produced by the under-water explosion. Oscillations of such bubbles cause the abnormal waves which disturb reflection records. They are prevented by increasing the charge, i.e. the radius of the bubble, so that the surface breaks before the contraction occurs, or by bringing it closer to the surface. At 38 ft at least 1 000 lbs of explosive would be required to prevent oscillation; thus in deep water the charge must float at a reasonable depth. A. B.

550.834 1982

Refraction waves reflected from a fault zone. ROBINSON, W. B. *Geophysics*, **10**, 535–45 (*Oct.*, 1945).—Explanation of the many records with excessive step-out times (30%), yielded by a seismograph project in Webb County, Texas. A. B.

550.93 1983

An estimate of the age of the earth. HOLMES, A. *Nature, Lond.*, **157**, 680–4 (*May* 25, 1946).—Calculations are based on Nier's measurements of the isotopic Pb contents of 25 different lead ores [Abstr. 1936 (1941)]. Pb^{204} is not generated by any radioactive process, and the contents of Pb^{206}, Pb^{207} and Pb^{208} are expressed relative to Pb^{204} content. On the assumption that ores solidify at different times from a material composed of "primeval lead" (existing at the origin of the earth) together with the decomposition products of U, Ac and Th, it is possible to get an estimate from a pair of ores of the date at which the primeval lead commenced accumulating these products. A number of such pairs of ores give a consistent value for the age of the earth as about 3 000 million years, and the composition of "primeval lead" in terms of Pb isotopes, U and Th can be calculated.

551.465 : 551.526.6 1984

Water circulation and surface boundaries in the oceans. DEACON, G. E. R. *Quart. J. R. Met. Soc.*, **71**, 11–24 (*Jan.–April*, 1945).—Due to prevailing winds and partly to convectional forces caused by thermohaline effects water flow is controlled. The Antarctic Convergence or Oceanic Polar Front and

the Subtropical Convergence depend for their position and formation on deep water circulation. The current flow at various levels is discussed and charts are used to indicate these boundaries. The convergence is shown by sharp temperature differences, distinctive fauna of floating animal life and differences of marine sediment. There is less regularity in the boundaries in the northern hemisphere due to the distribution of land and water. R. S. R.

METEOROLOGY 551.5

551.50 : [621.311.153.2 + 621.315.1.056] 1985

Discussion on "weather and electric power systems." FORREST, J. S., GRIMMITT, H. W., DRUMMOND, A. J., AND POULTER, R. M. *J. Instn Elect. Engrs, Pt I*, **93**, 161–76 (*April*, 1946).—A summary of 4 introductory papers followed by a discussion at a joint meeting of the I.E.E. and the R. Met. Soc., 18 Oct., 1945. Statistical data are required by the power engineer mainly for design of outdoor equipment and for correlation with load variations. Forecasts are needed in preparing loading and maintenance programmes and short-range warnings of thunderstorms and frosts enable the operating engineer to take precautions against breakdown or to make alternative circuits available. Wind load conditions and ice storms are discussed with reference to recent breakdowns experienced on overhead lines. The sources of British meteorological data are given and some features of the records of cold spells, rainfall intensity and humidity are discussed. The apparatus used in radio-sonde investigations of atmospheric stability is described and the $T\phi$ diagram is explained. J. A. W.

551.508.99 : 551.576.4 1986

The cloud range meter. MOLES, F. J. *Gen. Elect. Rev.*, **49**, 46–8 (*April*, 1946).—Light pulses are transmitted from a h.v. spark gap at the focus of a parabolic reflector, to the cloud under observation, and the reflected pulses, received in another parabolic reflector, operate a photo-cell and high-gain amplifier. The two reflectors are mounted on the same support and so turn together. Measurements of the time interval between the transmission of a pulse and the reception of the reflected pulse are made on a 5 in long-persistence oscillograph in a manner similar to radar. The high intensity sparks are produced by the periodic discharge of a condenser charged to 10 kV, the flashes being repeated at 60 c/s. Al electrodes, of diameter $\frac{1}{4}$ in, are used. The range is 500–7 000 ft. The equipment is portable, its 3 sections weighing <150 lbs each. A. W.

551.509.3 1987

An enquiry into the possibilities and limits of statistical weather forecasting. SCHUMANN, T. E. W. *Quart. J. R. Met. Soc.*, **70**, 181–95 (*July*, 1944).—The statistical method essentially amounts to the prediction of the weather element P at a station A by means of the regression equation, $P = k_1x_1 + k_2x_2 + \ldots k_nx_n$ in which $x_1 \ldots x_n$ are the values of a number of weather elements observed at the control stations $B_1 \ldots B_n$ a specified time before P is observed, and the regression coefficients $k_1 \ldots k_n$ are computed from previous records of the weather elements P, $x_1 \ldots x_n$. The reliability of the predicted value of P depends upon the numerical value of the multiple correlation coefficient between P and $x_1 \ldots x_n$ and there exists a limiting maximum value M_z of this correlation coefficient. By the suitable selection of a limited number of control stations this maximum value can be ascertained to a very close degree of approximation. Research should be directed towards determining the value of M_z for different values of the time lapse z, over which the prediction is made. Once the value of M_z has been found, there is available a direct method of judging between the relative merits of statistical and current weather prediction. The method has been tested for pressure at Pretoria in a preliminary way, but a much wider investigation is in progress. R. S. R.

551.509.34 1988

A frost prediction diagram. LÖNNQVIST, O. *Ark. Mat. Astr. Fys.*, **32 A** (*No.* 4) *Paper* 13, 7 *pp.* (1946).—Brunt's formula to predict the night minimum temperature from sunset temperature, duration of the night, nocturnal radiation and a factor based on the nature of the surface, with radiation depending on cloudiness and water vapour content of the air, was used by Dufour to construct a series of tables for normal and wet ground with different lengths of night. Diagrams are now given to obtain the fall of temperature Δt for any sunset temperature, any relative humidity, any night duration and with normal or wet ground and for clear, overcast or partly clouded nights. The diagrams were tested over 538 cloudless cases at Tiflis and accurate predictions ranged from 100% in summer to 68% in winter within the known conditions. The diagram can be used for fog prediction where use is made of Petterssen's diagram giving the cooling required to produce fog when air temperature and humidity are known. R. S. R.

551.510.535 1989

Two anomalies in the ionosphere. APPLETON, E. V. *Nature, Lond.*, **157**, 691 (*May* 25, 1946).—Observations at many new ionospheric stations during the war have disclosed an asymmetry of ionization of the F_2 layer with respect to the equator, under conditions of symmetrical solar illumination. Further, equinox noon values for sites of the same latitude but different longitude, are also different. These anomalies disappear when plotted relative to magnetic dip. There appears to be, for noon equinox conditions, a belt of low values of f_{F_2} situated on the magnetic equator, and associated with marked bifurcation of the F layer into F_1 and F_2.

551.510.535 : 525.75 = 3 1990

Night sky light intensity measurements. HECHTEL, R. *Hochfrequenztech. u. Elektroakust.*, **58**, 153–6 (*Dec.*, 1941) *In German.*—The night sky light intensity has been measured by photometric methods in three different spectrum-ranges on 61 nights. The average night light intensity seems to follow an annual law very similar to that of midday limit frequency of the F_2-ionosphere layer. This, and several other observations, can be explained by cosmic radiation phenomena. A. L.

551.510.535 : 551.594.12 1991

On the electrical state of the upper atmosphere. FERRARO, V. C. A. *Terr. Magn. Atmos. Elect.*, **50**,

223–9 (*Sept.*, 1945).—Wu's suggestion that there may be a high preponderance of positive ions in the *E* layer [Abstr. 311 (1946)] is shown to be untenable, firstly, because (contrary to Wu's supposition) the dynamo-theory of the *S*-field requires, at most, an excess of 0·1 charges (10^{-11} e.s.u.) of one sign over the charges of opposite sign in a column 1 cm² cross-section drawn vertically in the *E* layer; and secondly, because a concentration of positive ions as postulated by Wu would produce electric fields so large that the atmosphere could not hold together under gravity against the mutual repulsion of its parts. V. C. A. F.

551.510.535 : 551.594.13 1992

Diffusion of ions in the ionosphere. FERRARO, V. C. A. *Terr. Magn. Atmos. Elect.*, **50**, 215–22 (*Sept.*, 1945).—The equation of diffusion applicable to the ionosphere is derived afresh and an error in Hulburt's earlier derivation [Abstr. 3278 (1928)] is corrected. It is shown that in the *E* and F_1 layers diffusion is negligible, but that it begins to be perceptible in the F_2 layer. An approximate integration of the equation of diffusion is carried out on the supposition that in the F_2 layer the effective coefficient of recombinations is of the order of 10^{-10}, and that the temperature and density of the air are respectively of the order of 1 000°K and 10^{10} molecules/cm². The results suggest that diffusion lowers the F_2 layer as a whole by not more than a quarter of a scale height, whilst hardly affecting the maximum electron density. V. C. A. F.

551.513 : 550.384 1993

On the relation between geomagnetism and the circulatory motions of the air in the atmosphere. WULF, O. R. *Terr. Magn. Atmos. Elect.*, **50**, 185–97 (*Sept.*, 1945).

551.515.11 1994

The normal and power vortex in meteorology. JAMES, R. W. *Nature, Lond.*, **157**, 693 (*May* 25, 1946).

551.524.4 : 551.551 1995

The evaluation of the coefficient of eddy diffusivity. LONGLEY, R. W. *Quart. J. R. Met. Soc.*, **70**, 286–92 (*Oct.*, 1944).—Observational data for Leafield have been substituted into a modified form of the equation of heat transfer. By a statistical analysis of the resultant equations, values of the coefficient of eddy diffusivity for various stable lapse rates are obtained. It was found necessary in the analysis to define a "point of best fit," and to derive the normal equations for obtaining this point. R. S. R.

551.526.6 : 551.465 *see Abstr.* 1984

551.551 : 551.524.4 *see Abstr.* 1995

551.576.4 : 551.508.99 *see Abstr.* 1986

551.583 1996

Some recent contributions to the study of climatic change. MANLEY, G. *Quart. J. R. Met. Soc.*, **70**, 197–219 (*July*, 1944).—A survey is made of the large amount of material regarding regions in which climatic variations have most effect. The interpretation of post-glacial and historic variations of climate is based on pollen analysis from peat bogs and thus of tree growth. The investigations of Ahlmann and others on the economy of glaciers round the Norwegian Sea shows temperature to be the dominant factor. Changes of seasonal temperature in these areas are illustrated. These changes are attributed to a more vigorous circulation in the Norwegian Sea and a warming in the Arctic. Finally, changes in Central Asia are considered, together with possible causes. R. S. R.

551.584 1997

Some factors in micro-climatology. BRUNT, D. *Quart. J. R. Met. Soc.*, **71**, 1–10 (*Jan.–April*, 1945).—An account is given of climatic variations due to differences of soil, soil drainage, soil cover, aspect or contour. Variations are sometimes great due to these causes even over distances of a few hundred yards. R. S. R.

551.594.12 : 551.510.535 *see Abstr.* 1991

551.594.13 : 551.510.535 *see Abstr.* 1992

551.594.221 : 621.316.933 : 537.523.4 = 3 1998

Cathode-ray oscillograph examination of lightning. NORINDER, H. *Elektrotech. Z.* [*ETZ*] **62**, 617–21 (*July* 10, 1941) *In German.*—Oscillograms are shown of a cold and a hot lightning stroke and the physical effects observed are described in detail. The hot lightning stroke is characterized by longer duration of the discharge current, often consisting of several impulses separated by current-less intervals. In the case discussed, the first impulse reached 22·5 kA in 20 μsec and some fluctuations of 1 kA/μs were observed. The second impulse reached only 5 kA in 200 μsec. The total duration was about 1 000 μsec. The efficiency of current surge protection is briefly discussed. J. A. W.

551.594.5 : 535.338.1 *see Abstr.* 1849

BIOLOGY 57/59

578.088.5 1999

Chain processes and their biophysical applications. I. General theory. OPATOWSKI, I. *Bull. Math. Biophys.*, **7** (*No.* 4) 161–80 (*Dec.*, 1945).—A mathematical theory is developed which may be applied to the biological effects of radiation considered as chain processes. The theory is interpreted as a "hit theory" involving the concept of "sensitive volume." The variability of the sensitivity of the organism to the radiation is taken into account. In a continuous irradiation of a biological aggregate in which the effect of each single hit cannot be observed, recovery and variation of sensitivity are formally equivalent. Methods for the calculation of the "number of hits" and for the determination of the kinetics of the processes are given. The relation between the recovery and the Bunsen–Roscoe law is discussed. L. S. G.

591.112.3 : 532.517 2000

The flow of a viscous fluid in an elastic tube: a model of the femoral artery. BRANSON, H. *Bull. Math. Biophys.*, **7** (*No.* 4) 181–88 (*Dec.*, 1945).—The solutions of the differential equations for the flow give a description of some aspects of the flow of blood in the

femoral artery. The parameters influencing the speed of the pulse wave, the pressure and the velocity for non-pulsating and pulsating flow are exhibited. The relation between pressure and velocity is considered. For pulsating flow the slope of the pressure/fluid-velocity curve is equal to the pulse wave speed multiplied by the density of the blood. L. S. G.

591.185.63 : 591.5 : 525.37 = 3 2001

The physical possibility of a biological sense of orientation based on the rotation of the earth. ISING, G. *Ark. Math. Astr. Fys.*, **32 A** (*No.* 4) *Paper* 18, 23 *pp.* (1946) *In German.*—The hypothesis that the sense of orientation in migrating birds is connected with the earth's magnetic field is rejected on the grounds of the secular variation of the field, and the assumption of an organ acting on gravimetric principles is untenable for slowly moving animals. It is suggested that an explanation may be found in the action of the earth's rotation on the motion, relative to the remainder of the body, of a fluid in some organ, probably in the ear. It is shown that the deviating force on a narrow tube in which a liquid flows is analogous to the force on a current-carrying conductor in a magnetic field, the flux density B corresponding to twice the earth's rotation vector. This is confirmed experimentally. When a tube full of liquid is bent into a closed loop, motion in the rotation field induces a hydromotive pressure following the same law as the induced e.m.f. in a closed conductor. The question of a special organ for the sense of locality is discussed. J. A. W.

591.5 : 525.37 : 591.185.63 = 3 *see Abstr.* 2001

MEDICAL SCIENCE 61

612.84 2002

Correcting the spherical and chromatic aberrations of the eye. VAN HEEL, A. C. S. *J. Opt. Soc. Amer.*, **36**, 237–9 (*April*, 1946).—Partial or complete correction of the spherical aberration of the eye does not influence visual acuity or contrast appreciably. A system, correcting also the chromatic aberration of the eye, gives, with white light, a sharp image, which shows somewhat better contrast than the naked eye. This system has been used for several years in a trichromatic colorimeter. [See Abstr. 225 (1935)].

612.843.32 = 4 2003

An apparatus for rapid recording of the chromatic sensitivity of the eye. DEVAUX, P. *Bull. Soc. Franç. Élect.*, **3**, 112–14 (*April*, 1943) *In French.*

612.845 = 4 2004

Relative sizes of the two retinal images. GRAMONT, A. *Rev. Opt. (Théor. Instrum.)* **21**, 1–14 (1942) *In French.*—Discusses the case of the two eyes of a patient being of different powers, thus producing images of different sizes; fusion is difficult and errors in the estimation of distance and size result (aniseikonia). The various causes of this are examined and an instrument (the logoscope) suitable for measuring the defect is described. Details are given of the methods of calculation which enable correcting glasses to be designed which ensure equality of the size of the images. A. H.

614.898 : 621.386.86 2005

Protection against high energy X-rays. FAILLA, G. *Amer. J. Roentgenol. and Radium Ther.*, **54**, 553–82 (*Dec.*, 1945).—The extended use of X-rays in industry has resulted in there being over 70 installations which operate at 1 MV or over, up to 2 MV as compared to only a few in therapeutic use of 1 MV or upwards. 20 and 100 MV apparati have also been built and operated. Such high voltage operation has left gaps in protection problems which have been more or less empirically solved on past experience. The half-valve layer is used for the solution of protection problems and details of absorption curves are given graphically, up to values to 10 000 eMV. Transmission of radiation via varying thicknesses of lead and concrete is likewise illustrated. It is difficult to reproduce in laboratories the conditions of industrial operation. For multimillion-volt apparatus protection peculiar problems arise. Lead is very efficient but concrete, whilst less efficient, is more practical for large barriers. Variation of distribution in the human body submitted to the radiation also occurs, and a permissible dose is less than 0·1 r daily. B. J. L.

614.898 : 621.386.86 2006

Protection against X-rays and gamma rays. QUIMBY, E. H., STONE, R. S., HENSHAW, P. S., TAFT, R. B., HENNY, G. C., SINGER, G., AND LAURENCE, G. C. *Radiology*, **46**, 57–76 (*Jan.*, 1946).—Quimby deals with the permissible tolerance dose of radiation which can be received, Stone discusses the injuries incurred by undue exposure, Henshaw the injuries suffered with regard to genetic future, Taft the human factors affecting protection, Henny protection in industrial screening procedures, Singer and Laurence discuss, with graphical data, materials such as lead and concrete used for protection. B. J. L.

615.831 : 536.33.08 *see Abstr.* 1877

666.189.3 : 534.833.4 *see Abstr.* 1835

669.6 : 548.524 = 393 *see Abstr.* 1964

669.65 : 548.73 *see Abstr.* 1969

669.715.3 : 536.666 *see Abstr.* 1885

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771.531.1–834 : 539.16.08 *see Abstr.* 1925

778.31 : 541.185 *see Abstr.* 1956